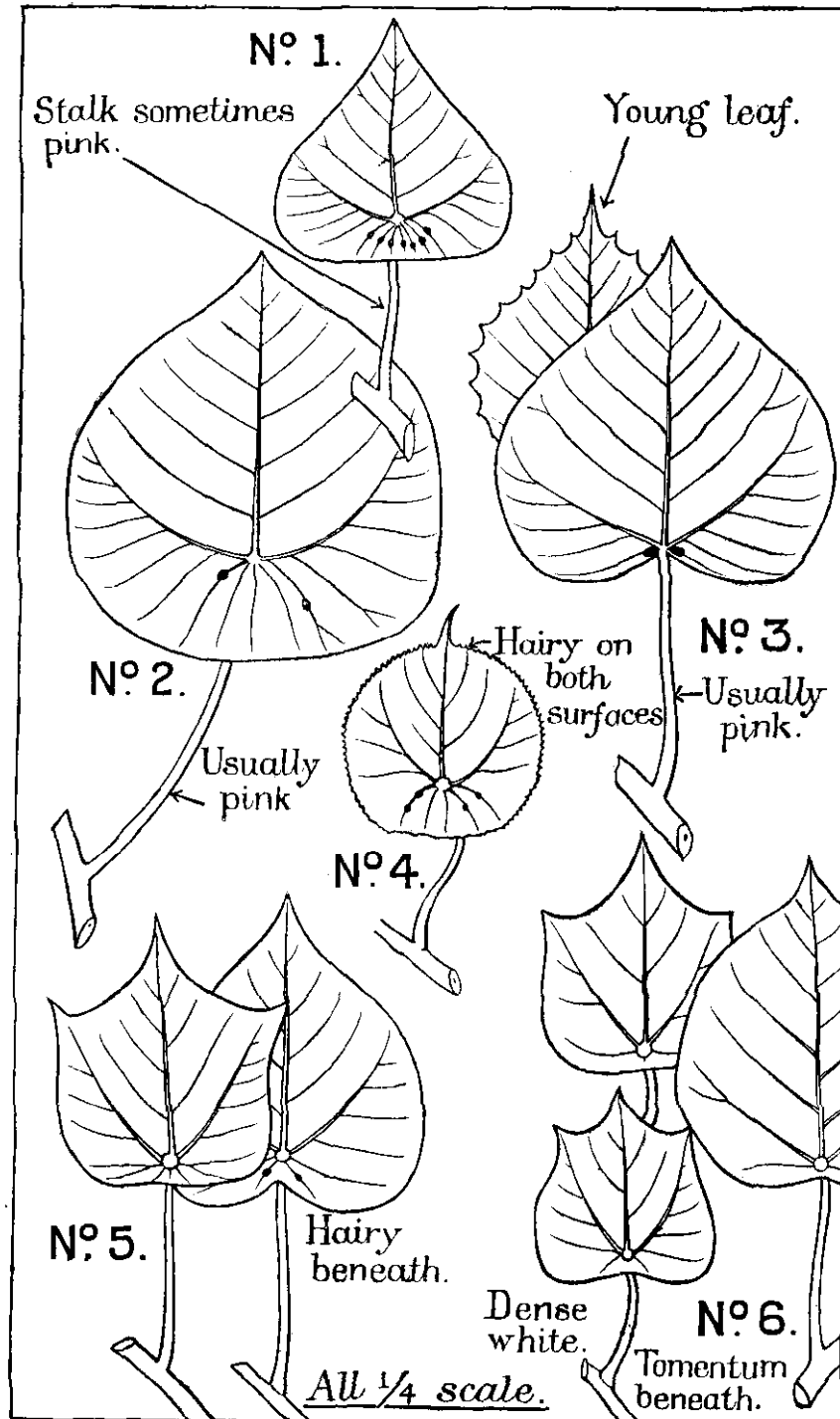


THE MALATAS OF NORTHERN BENGAL.



Veda Ballabh.

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THE MALATAS OF NORTHERN BENGAL.

I am grateful to Mr. Cowan for his article under this heading in the April issue of the *Indian Forester*. It has undoubtedly helped to clear up a confusing group of trees but I am not altogether satisfied with it.

My complaints are three :—

1. In an article on the *malata* I do not think it was necessary to include all the Northern Bengal species of *Macaranga* and *Mallotus*. Some of them, notably *Mallotus philippinensis*, are never called *malata* and their inclusion only serves to confuse the issue.

2. The key failed in the field when applied to the common high-level *malata* (which I have called No. 5). If I am right in thinking this species to be *Mallotus nepalensis*, the fault lies in keying (and illustrating) the leaves as "much longer than broad" and in describing them as *entire* with a *dense* stellate tomentum. These characters are true of the small terminal leaves (which being nearest the inflorescence are sometimes the only ones preserved in herbarium specimens) but not of the general foliage.

3. Some of the leaves illustrated are not, to my mind, at all typical in shape and are not to scale. The shape may be a matter of opinion but the size does not agree with the text (nor with nature in this part of the world).

Although there may be other less common *malatas* I think there are six main species which have, so to speak, lost their

identity under this collective name. I have reduced Mr. Cowan's list of nine by omitting *Mallotus philippinensis* (because it is not a *malata*), *Mallotus repandus* (because it is not a tree) and *Macaranga Gamblei* (because I do not know it, think it is rare, and doubt if it is called *malata*).

I have tried to sketch and describe the remaining six so that they can be recognised in the forest.

No. 1 is the commonest *malata* of the plains which, under the influence of fire-protection, has covered hundreds of acres of savannah and old village sites with an almost pure crop. It reaches the foot of the hills but does not as a rule ascend far, being replaced by No. 2, though I have once found a straggler at 3,100 feet. The leaves, which are triangular, are moderately widely peltate—from 4% to 11% (average 7%) of their total length. The leaf-stalk is sometimes pink but not so conspicuously as in Nos. 2 and 3. The blaze is thin, through pinkish-brown to the white wood. It is known in Nepalese simply as *malata* or, if it is to be specially distinguished from other species, as *adol* (i.e. plains) *malata*. I think it is *Macaranga denticulata* Muell. Arg.

No. 2 is the *malata* with very large, almost circular, leaves, very widely peltate (18 % to 25 %, average 20 %) with a long pink stalk. It is comparatively rare in the plains proper but common near the foot-hills and ascends to 5,000 ft. in large numbers and, as an occasional tree, to 6,000. It is less gregarious than either Nos. 1 or 3 with both of which it is found in mixture, with the former at its lower and with the latter towards its upper limit. To a very casual observer it might be mistaken for either. The largest tree I have measured at 4,000 ft. was 3 ft. 6 ins. in girth. The blaze is yellowish with brown marks in the larger trees. It is known in Nepalese as *jogi malata* but this name is also applied to No. 6. This name refers to the greyish under-side of the leaves, in allusion to the habit *jogis* have of smearing themselves with ashes. I believe this tree to be *Macaranga indica* Muell. Arg.

No. 3 is the gregarious *malata* of the hills from about 3,000 to 5,500 ft., though it continues as an isolated tree up to about 6,500 ft. Its foliage has a superficial resemblance to that of

No. 1 though, at close quarters, the barely peltate leaves, which are generally rather pentagonal than triangular in shape, are a sufficient distinction. The habit of the two trees is, moreover, very different, No. 1 is low, spreading and flat-topped, whereas No. 3 is tall and slender with horizontal branches. This is the largest of the *malatas* (Osmaston records a tree near Palongdong 11 ft. in girth) also the only one used for planking, the timber being reddish and quite useful. The bark, in large trees, is thick and the blaze reddish brown. The Nepalese names are *chilia* (=glabrous) *malata* or *jat* (=true) *malata*. I believe it to be *Macaranga pustulata* Muell.Arg.

No. 4 is usually a very small tree growing in moist places in the plains and valleys of the foot-hills. It is distinguished from all other *malatas* by having stellate hairs, visible with a pocket lens, on both surfaces of the leaf. The leaf-stalk is always green. In Nepalese it is called *phusre* (=tomentose) *malata*, a name also used for the hill species No. 5. I believe it to be *Mallotus Roxburghianus* Muell.Arg.

No. 5 is the high-level *malata* very common, though not usually gregarious, from 6,000 to 8,000 ft. and occurring lower. The lowest elevation at which I have seen it is 5,700 ft. but both Gamble and Cowan record it to 5,000. The foliage resembles that of No. 6 and, like it, the leaves vary from heart-shaped to maple-shaped, but they have not such a heavy tomentum beneath so that the green of the under-side is always visible, though numerous stellate hairs can be seen with a lens. Saplings usually have as many maple-shaped as heart-shaped leaves, in large trees the latter shape predominates though even the largest usually have a few maple-shaped leaves, especially if growing at the higher elevations. The blaze in young trees is yellowish, in larger ones deep reddish-brown. It shares with No. 4 the Nepalese name *phusre malata*. I believe it to be *Mallotus nepalensis* Muell. Arg.

No. 6 is the *malata* with conspicuously white under-side to the leaves, a dense tomentum of stellate hairs completely hiding the green surface (except sometimes in young saplings).

Like the last the leaves are variable but more commonly maple-shaped than heart-shaped. The stalks are green. It grows gregariously in the plains, sometimes, for no apparent reason, replacing No. 1 over considerable tracts. It also ascends the hills to 5,000 ft. (according to Gamble and Cowan, the highest I have found it was 3,700). It shares with No. 2 the name *jogi malata*. I believe it to be *Mallotus albus* Muell, Arg.

One of the reasons for the confusion among *malatas* in Bengal is that the identifications in Gamble's Darjeeling List (which has always been Northern Bengal's botanical bible) have been more upset in *Macaranga* than in any other genus. I give below a list of Gamble's species together with what, to the best of my knowledge, are their present identifications:—

Gamble's Darjeeling List.	Present identification (?)
<i>Macaranga pustulata</i> .	? but not <i>M. pustulata</i> .
" <i>gmelinifolia</i> .	Now included in <i>M. pustulata</i> .
" <i>Gamblei</i> .	<i>M. Gamblei</i> .
" <i>denticulata</i> .	<i>M. pustulata</i> .
" <i>gummiflora</i> .	<i>M. indica</i> .
" <i>indica</i> .	<i>M. denticulata</i> .
" sp.	<i>Croton Tiglium</i> .

I would key the six species which I consider to be the common Northern Bengal *malatas* thus:—

- A. Stellate hairs on the lower surface of the leaf visible with a pocket lens. Leaves either entire or toothed (serrate or palmately denate). Leaf-stalk never red. Inflorescence terminal.
 - (a) Stellate hairs on *both* surfaces. Leaves peltate, roughly circular in outline with a long tip. Plains and foot-hills No. 4 (*Mallotus Roxburghianus*?).
 - (b) Stellate hairs (on lower surface only) forming a dense tomentum which entirely conceals the green of the under-side (except in very young plants). Leaves heart-shaped or maple-shaped, sometimes

broadly but usually very narrowly peltate. Twigs and young parts rusty. Plains to 3,500 feet.

No. 6 (*Mallotus albus* ?)

- (c) Stellate hairs (on the lower surface only) soft to the touch but not dense enough to conceal the green of the under-side of the leaf. Leaves heart-shaped or maple-shaped, very narrowly peltate. 5,000 to 8,000 feet.

No. 5 (*Mallotus nepalensis* ?).

B. No stellate hairs on the leaves. Leaves entire (except a serrate edge on very young leaves). Leaf-stalk usually with some pink on it. Inflorescence *not* terminal.

- (a) Leaves very narrowly (inconspicuously) peltate 3,000 to 5,500 feet.

No. 3 (*Macaranga pustulata* ?).

- (b) Leaves peltate by 4 to 11 per cent. of their total length. Plains to (rarely) 3,000 feet.

No. 1 (*Macaranga denticulata* ?)

- (c) Leaves very broadly peltate, by 18 to 25 per cent. of their total length. Plains (rarely) and foot-hills ascending to 6,000 feet.

No. 2 (*Macaranga indica* ?).

There are two plants, one in the plains and one in the hills, which may be mistaken for *malatas*. The leaves of immature trees of *Sapium baccatum* are peltate and with their pink stalks and rounded shape look like miniature leaves of No. 2 and are often called *malata* by inexperienced coolies. In the hills, at about 6,000 feet, young shoots of *Alangium alpinum* (called properly *akhane* in Nepalese) come up on *taungyas* together with No. 5 and, being rather like it in appearance, are often called *malata* even by old experienced forest guards.

E. O. SHIEBBEARE, I.F.S.

A PRELIMINARY NOTE ON THE USE OF ACACIA CATECHU (KHAIR) AS A HOST ALTERNATIVE WITH SCHLEICHERA TRIJUGA (KUSUM) FOR THE CULTIVATION OF TACHARDIA LACCA (LAC).

BY DOROTHY NORRIS, M.SC., A.I.C., H. T. BATES AND
M. RANGASWAMI, B.A.

Introduction.—Reports having been received from the Forest Department, Bihar and Orissa, that in Palamau District, *Acacia Catechu* was used by the villagers there as an alternative host for *Schleichera trijuga* lac, it was decided to test these facts at the Indian Lac Research Institute, Namkum, Ranchi.

Botanical note.—*Acacia Catechu* (*khair*) is a member of the sub-family Mimoseæ of the family Leguminosæ. It grows in two classes of forest: (a) Sub-himalayan and riverine, *i.e.*, on deep fairly well drained sandy and gravelly soils, occasionally subject to inundation by river floods during the monsoon. It is here gregarious and found with *Dalbergia Sissoo* and *Bombax malabaricum* as associates, and reaches its maximum development; (b) in miscellaneous dry and hill forests along with *Pinus longifolia*, *Boswellia serrata* and other xerophytic species, often on clayey soils where its development is much less generous.

It is found in such situations all over India and Burma, and while it is known as *khair* in Northern India, is called *kagli* or *shemi*, *karangalli* and *sandra* in Kanarese, Tamil and Telegu respectively. It is unexacting as to soil and the possibility of growing it almost anywhere in this country is therefore obvious.

It is ordinarily cut for the extraction (by boiling the heart-wood converted into chips) of cutch used in the dyeing and tanning industries and for *katha* the edible catechu used throughout India for chewing with "Pan supari." Its gum is used as a substitute for that of *Acacia arabica* and its wood makes a good fuel and converted into charcoal is valued by blacksmiths.

Its exploitation for any of the above purposes, which results in the felling of the tree, cannot compare with its use as a lac host, the yield in this case being annual.



Photographed in January 1928.
Fig. 2 — *Acacia Catechu* grown at Namkum, Ranchi, with manure and cultivation.
Age three and a half years.



Photographed in January 1928.
Fig. 1. — *Acacia Catechu* grown at Namkum, Ranchi, without either manure or cultivation.
Age three and a half years.

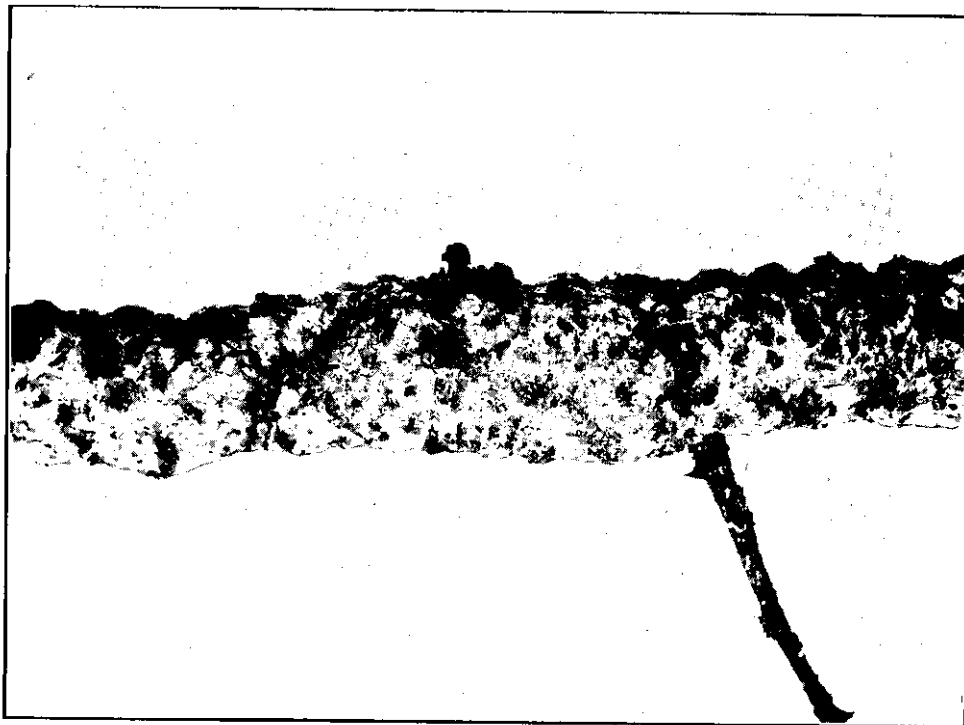


Fig. 3.—Photograph showing the type of incrustation on *Acacia Catechu* in February 1929.

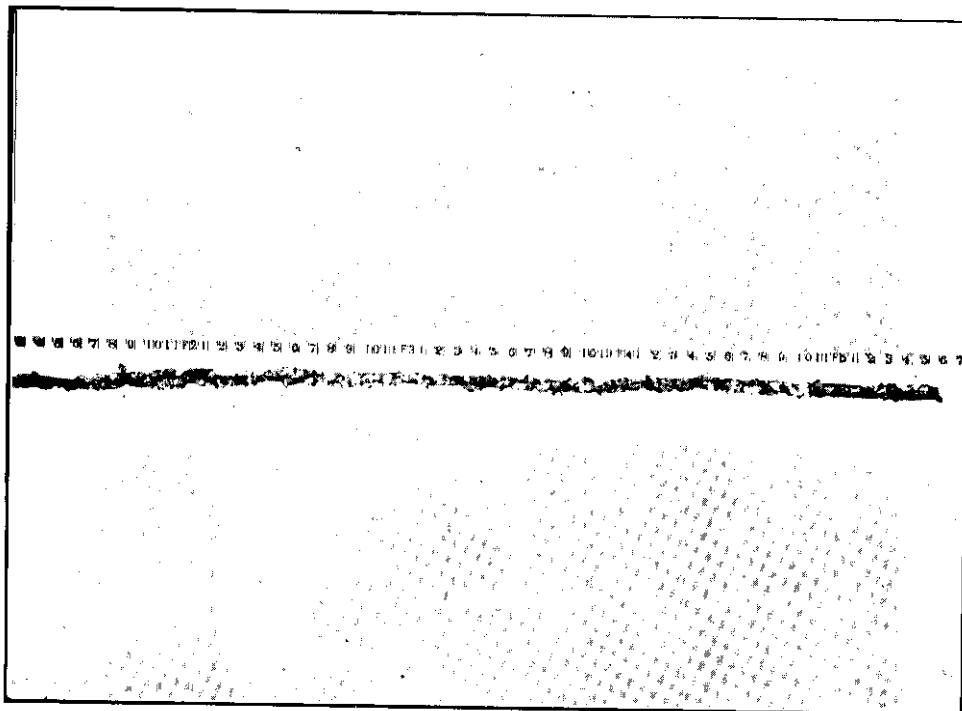


Fig. 4.—Photograph showing the length of incrustation which may be expected from a tree properly pruned beforehand.

Economic advantage of cultivating lac alternately on Schleicheria trijuga and Acacia Catechu.

Schleicheria trijuga yields a lac which is the most highly prized of those which find their way to the lac market, as a lac host however it has this drawback, that it can only yield a full crop once in three years. This may be because the high quality and the large quantity produced in such a crop exhaust this particular host tree more than is the case with other host trees.

Schleicheria trijuga lac swarms twice a year, January or February, and again in July or August, so that the two generations occupy approximately six months each. The owner of such trees has therefore six opportunities of obtaining crops of lac from them, only one of which or at the most two, he can utilise for sale as well as carrying on his infections. It is therefore of great importance to find an alternative host which can be made use of to fill the gap in another three out of these six opportunities, the period of comparative idleness for *kusum* trees being thereby reduced from 5/6 to 2/6 of the three year infection rotation.

These facts are best illustrated by figures. If a lac grower had at his disposal 600 *kusum* trees and 1200 *khair*, he would be able to utilise for infection annually, only 200 of the *kusum*. If the brood obtained from this infection was adequate he could then infect his 1200 *khair* trees. In the absence of the latter he would still only be able to make use of 200 *kusum* trees a year. Thus given the above numbers his opportunities of lac crop production are trebled for the three year infection period necessary for the cultivation of lac on *kusum*.

The experiments described below seem further to indicate that *kusum* brood lac is mutually transferable between *kusum* and *khair*, without any degeneration of the lac producing quality of the brood, also that the lac produced by this alternation is similar in quality from both hosts and held in equally high esteem by shellac manufacturers.

In view of the fact that a successful full crop of lac on *kusum* is not an annual occurrence, the experiments also seem to

point to the fact that the *kusum* brood is actually benefited by its temporary transference to *khair*.

The experiments also prove fairly conclusively that only one crop of lac per annum can be grown on *khair*, that from July to January (known as *aghani*) while both this and the February to July crop (known as *jethwi*) can be grown on *kusum*. This, as mentioned later in the paper, shows that *khair* brood is not a pure strain in as much as it requires to be retransferred to *kusum* for its continued existence.

In laying out the experimental plantation attached to the Indian Lac Research Institute provision was made for a block of eleven acres of *Acacia Catechu* and this was sown up with seed in June 1924. It was sown direct as seedlings do not transplant well. The spacing adopted was 15 feet triangular planting giving 222 trees to the acre and three or four seeds were sown per pit to allow for casualties.

The soil, which on analysis had been shown to be deficient in lime nitrogen and phosphate, was prepared by giving a broadcast dressing of 1,000 lbs. of lime per acre which was hoed in a few months prior to the seeds being sown. Germination was extremely good, but considerable damage was done at first by a species of cricket—*Gryllidae*—and handpicking had to be resorted to in order to eradicate the pest. During the first year, concentrated superphosphate at the rate of one lb. per tree was applied and also half an ounce of ammonium sulphate per tree. A green crop *Crotalaria juncea* was also grown throughout the area during the rains and hoed in when ready. During the second year a further application of half an ounce of ammonium sulphate was given and a second crop of *Crotalaria juncea* grown and hoed in as before.

Growth under the above conditions was extremely rapid and the attached photographs show the difference observed in growing the tree without manure or cultivation and with manure and cultivation.

This rapid growth compares very favourably with that of the superior lac host *Schleichera trijuga* (*kusum*) which is slow

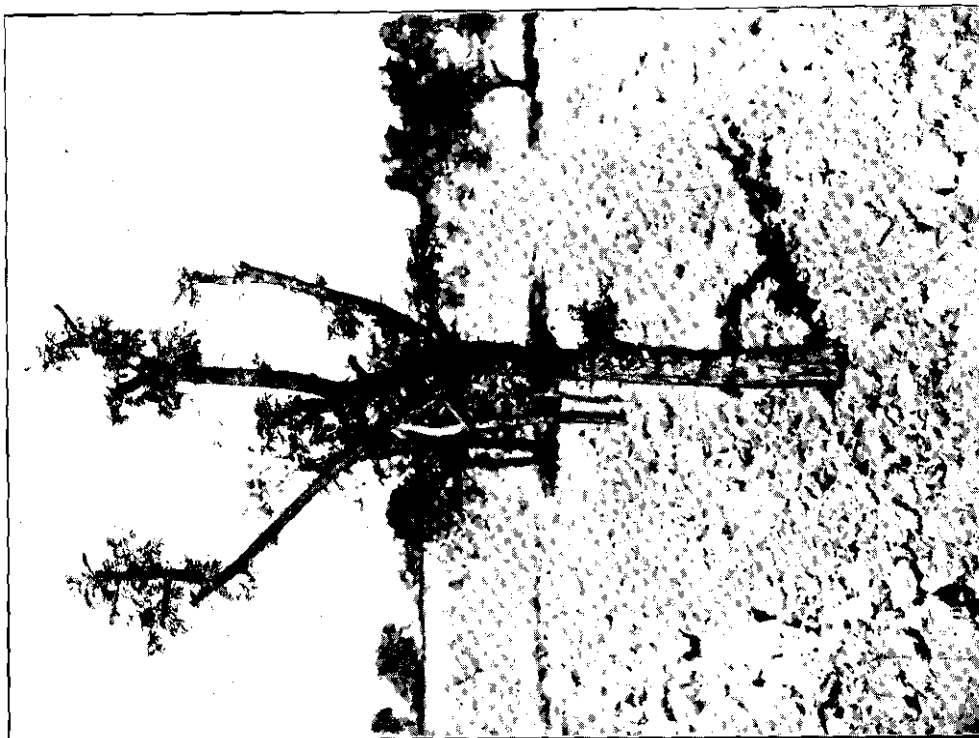


Fig. 6.—Pruned in October and photographed next February.



Fig. 5.—*Acacia Catechu* pruned in July and photographed next February

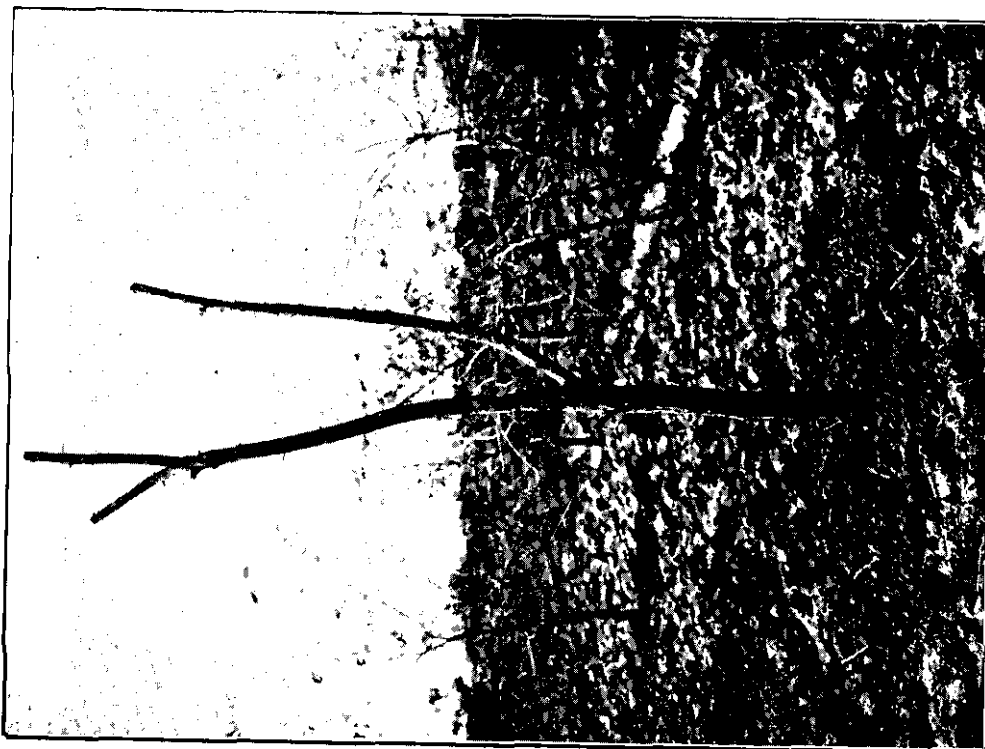


Fig. 8.—Pruned in December and photographed next February.

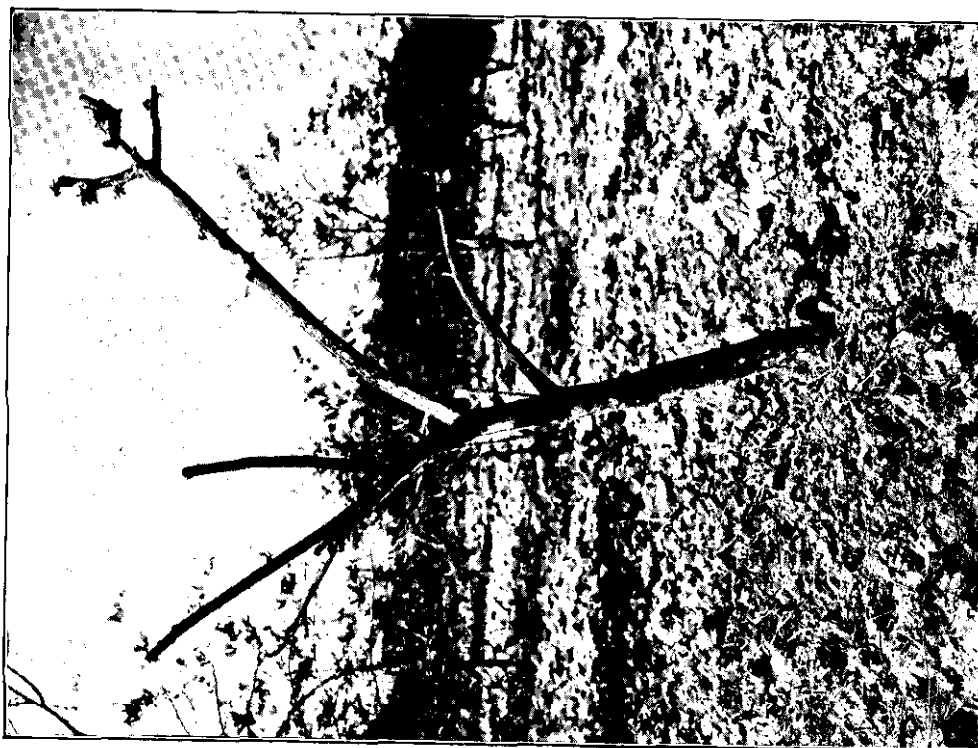


Fig. 7.—Pruned in November and photographed next February.

growing and as a result it was decided to try a light infection with brood lac obtained from *Schleichera trijuga*, in July 1926, on a portion of the block, that is to say when the trees were only two years old. An infection of only two to five ounces per tree was given and the results obtained in February 1927 were extremely encouraging and it was obvious that a much heavier infection might have been given without detriment to the tree. A fresh infection was not given until July 1927 when *Schleichera trijuga* brood was again used. Results were even more satisfactory than before, as on an average a yield of 11.4 lbs. of brood was obtained for every two pounds of brood used for infection. This brood sold at nearly the same price as pure *Schleichera trijuga* brood. Further infections were carried out in February 1928, July 1928, and February 1929.

The following figures show losses due to swarming, driage and sticks for *Acacia Catechu* and *Schleichera trijuga* over different years.

Loss figures for *Acacia Catechu* brood. (February crops).

	1	2	3	
Insect and moisture ...	33%	33%	28%	Average 31%
Sticks ...	26%	23%	37%	" 29%
Scraped lac ...	41%	44%	35%	" 40%

Loss figures for *Acacia Catechu* brood. (July crop).

Insect and moisture ...	38%
Sticks ...	50%
Scraped lac ...	12%

Loss figures for *Schleichera trijuga* brood. (February crop).

Insect and moisture ...	40%
Sticks ...	13%
Scraped lac ...	47%

Loss figures for *Schleichera trijuga* from two different sources. (July crops).

	1	2	
Insect and moisture ...	33%	45%	Average 39%
Sticks ...	28%	29%	" 28.5%
Scraped lac ...	39%	26%	" 32.5%

The lac grown on *Acacia Catechu* from July to February was used for the infection of *Schleichera trijuga* for the season February to July. The brood was found to take well on this host showing that an alternation between these two hosts was not only possible but successful.

The following instance shows results obtained in one season from the use of *Acacia Catechu* brood on *Schleichera trijuga* but needs further investigation in order to allow for other factors.

A block of *Schleichera trijuga* after being infected with its own brood for three successive seasons was then infected with *Acacia Catechu* brood. The resultant crop from this showed a 100 per cent. increase on the previous crop obtained and pending further work would seem to indicate that the alternate use of *Acacia Catechu* and *Schleichera trijuga* as hosts had an enormous effect on the vitality of the brood.

It is usual to regard *Schleichera trijuga* brood as superior to other varieties and to consider that, while brood from this host will always do well on other hosts, the reverse does not hold good. These experiments show that this is certainly not always the case and as it is considered possible that interchange of different types of brood may tend to keep up the vitality of the insect and lessen its susceptibility to parasites the point is quite important.

It must be remembered however that the brood and yield described above were not derived from *Acacia Catechu* only but were originally transferred from *Schleichera trijuga* brood. It had been hoped to carry out experiments in order to find out for how many generations the same type of brood could be continued on *Acacia Catechu* season after season, but experience has shown that this host in this district does not give a crop in July. This point will be dealt with later when considering pruning possibilities, although at the same time attention may be called to the factor of climate. For example these experiments have all been carried out in Chota Nagpur, where the climate from February to June may be exceedingly hot and dry. It is quite possible that in a moister climate such as in Assam pruning



Fig 10. —Same tree in August.

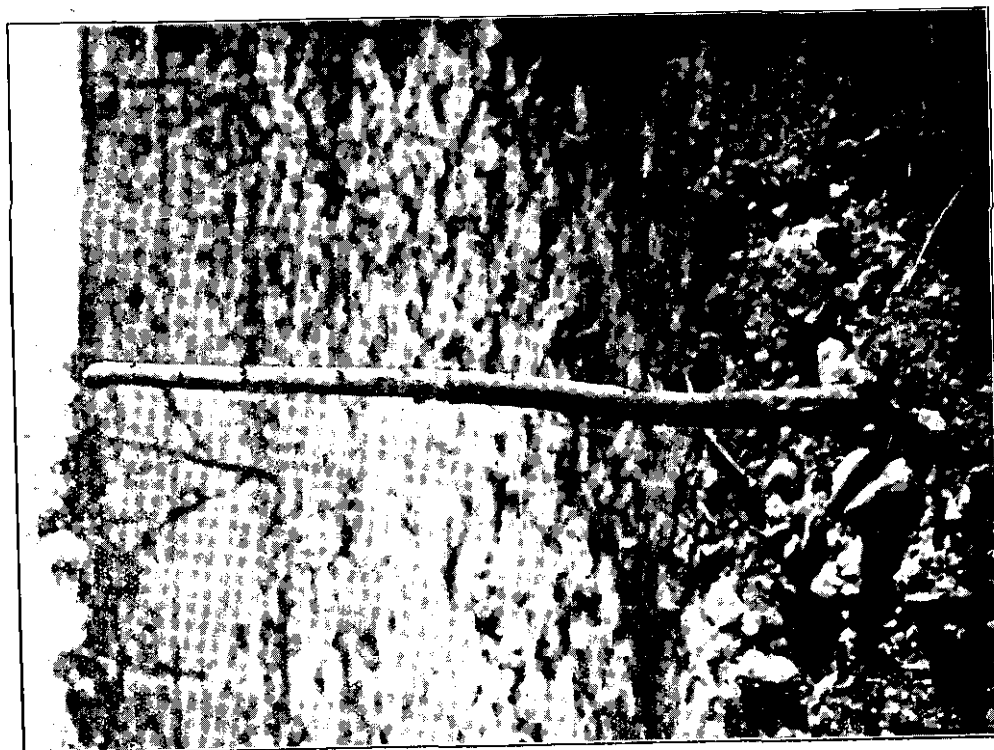


Fig. 9.—Cut flush with the fork.

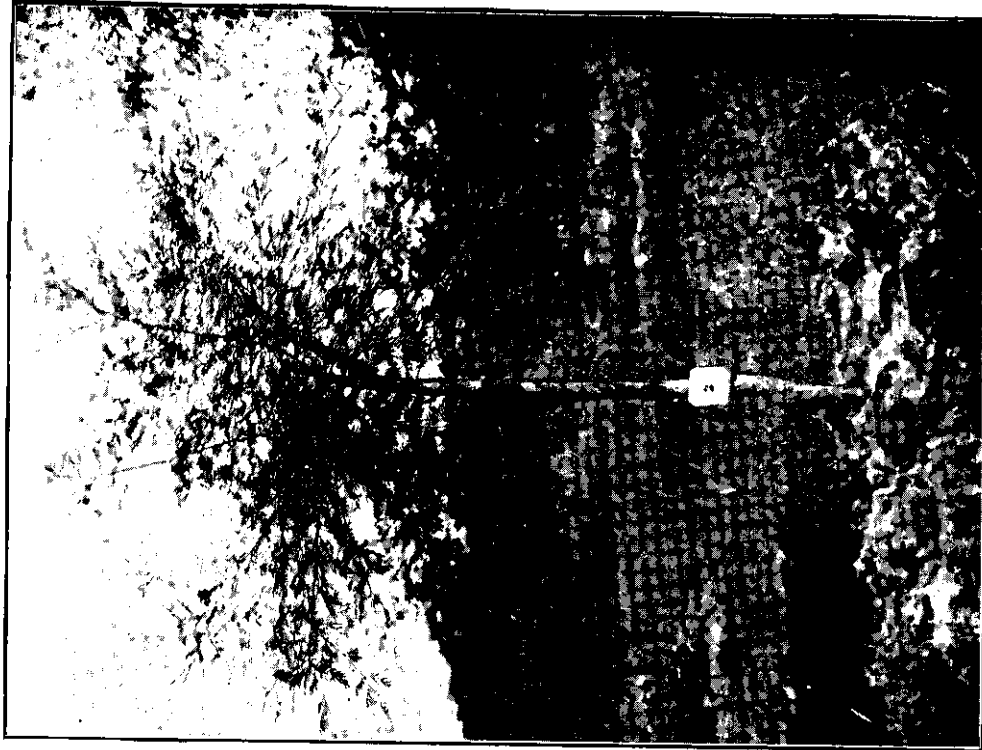


Fig. 12.—Same tree in August.

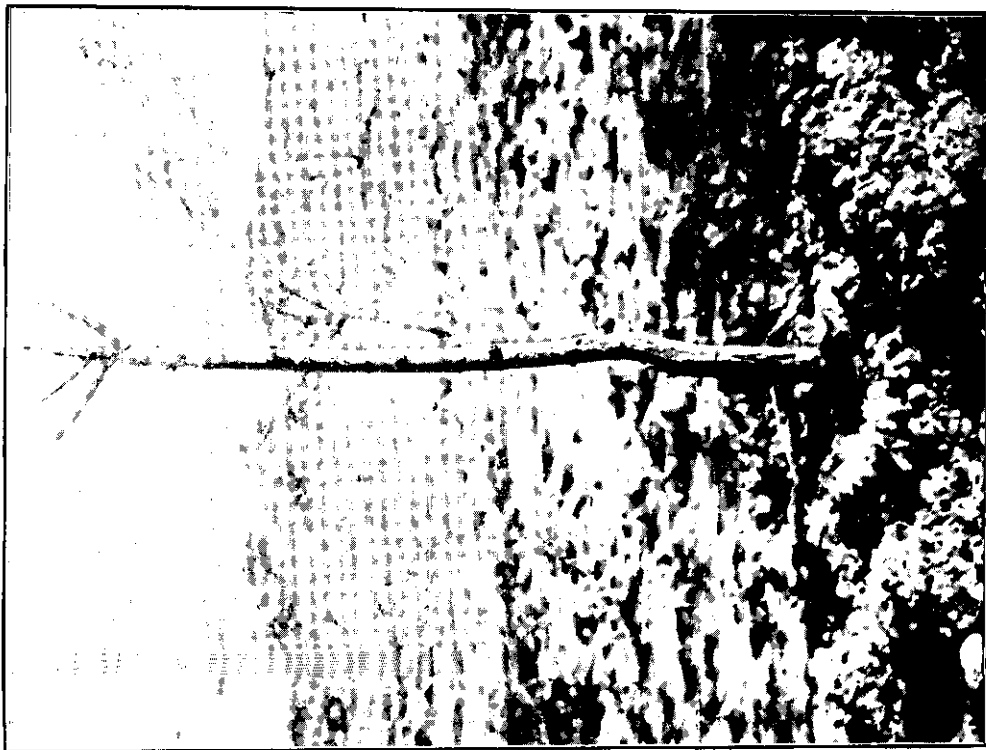


Fig. 11.—Cut 9.15 inches above the fork.

experiments might be more successful or that the insect itself might be better able to survive the hot season.

However from the results so far obtained it can definitely be stated that infection of *Acacia Catechu* in July with *Schleichera trijuga* brood is capable of yielding an excellent crop in the following February. Also that infection of *Acacia Catechu* in February with *Schleichera trijuga* brood has not so far been a success but this has only been tested over two seasons.

Experience points to the main difficulty being the impossibility of getting the tree to produce suitable shoots for infection at this time of year. Whereas a light pruning towards the end of April or early May results in excellent shoots becoming available for infection in July, it has so far been impossible to find any period for pruning which would result in good succulent shoots in early February.

The attached photographs show the results obtained for various times of pruning.

It would seem therefore that *Acacia Catechu* is a host which should be regarded as producing one crop only per annum when being alternated with *Schleichera trijuga*, at any rate in this district. The use of other broods such as that from *Butea frondosa* (*palas*) has not yet been worked out.

The following figures show the results obtained by infecting *Schleichera trijuga* with *Acacia Catechu* brood, and *Schleichera trijuga* with *Schleichera trijuga* brood but as they result from only two small scale trials they may be regarded as tentative.

Brood.	Brood infected.	Brood obtained.	Yield rate.
*Sch. X Ac.	8 lbs.	64 lbs.	8.0
Sch.	9 lbs.	52.5 lbs.	5.8

One large scale experiment has however been made giving the following results:—

144 lbs. of *Acacia Catechu* brood were used to infect 23 *Schleichera trijuga* trees at Sabaya, Ranchi District, in February

*Sch = Pure *Schleichera trijuga* brood.

Sch X Ac. = *Acacia Catechu* brood from a previous *Schleichera trijuga* infection.

1928, and the yield obtained in July 1928 was 572 lbs. which certainly bears out the results given for the small scale experiments which are tabulated above.

The lac obtained from *Acacia Catechu* is good in colour compared with that from *Schleichera trijuga* and now commands the same price in the local market as the latter.

As host *Acacia Catechu* does not appear so far to be so susceptible to pests as for example *Zizyphus Jujuba (ber)* either as regards pests on the host tree or pests on the lac.

Pending the completion of the experimental lac factory attached to the Institute, manufacturing data from stick lac to shellac have not been obtainable. This work will be taken up as soon as possible.

One of the problems taken up in connection with *Acacia Catechu* has been the finding of the best method of pruning the plants. Obtaining the maximum yield from a tree at a minimum cost depends to a large extent on the shape to which the tree is trained by means of a systematic pruning of the right type in successive seasons. It has been known in forestry that a number of desired shapes, like high crown or low crown, open centre or close centre, can be evolved by the use of particular types of pruning and in order to get the maximum yield from a tree such a system of pruning may be instituted by trial by which a large number of good succulent shoots result for infection and at a comparatively low height to save expenses on labour.

With this object in view, a beginning has been made with four types of pruning in May 1928 and the results of these tests will be seen in the attached plates.

Pruning has been done again in May 1929, selecting a suitable method of pruning according to the shape and it is intended to find out what shape the tree assumes at the end of two or three years under each system of pruning.

Experiments are also being carried out on manuring with various combinations of artificial fertilisers and also on various other ways by which yields and quality may possibly be increased and improved.



Fig. 14. —The same tree in August.

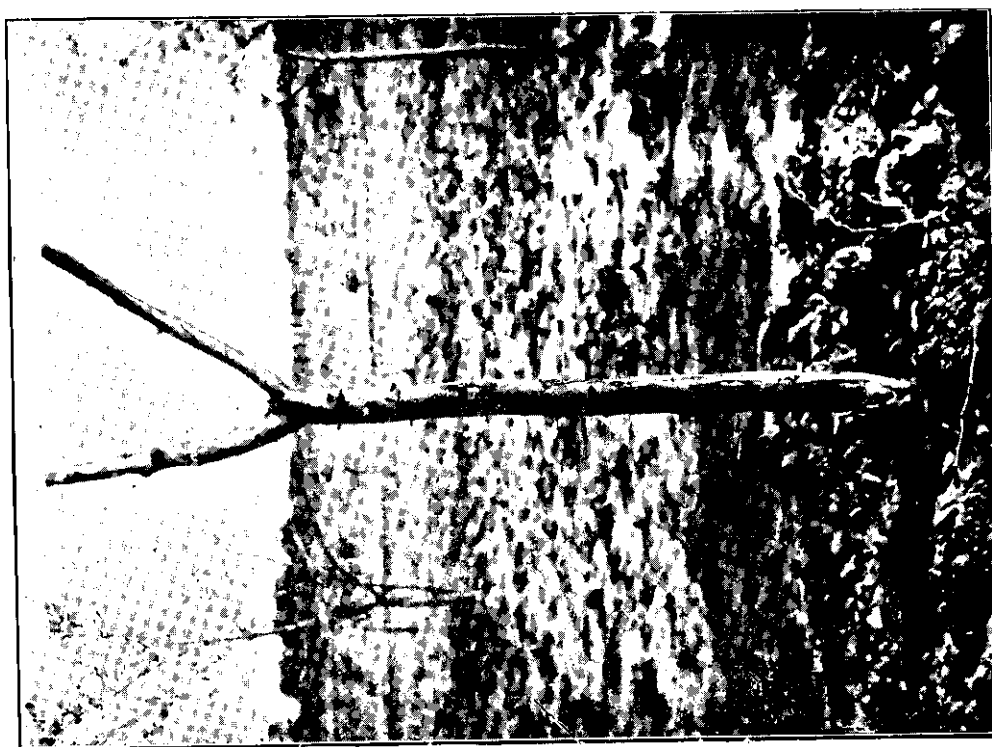


Fig. 13.—Cut 15-20 inches above the fork.



Fig. 16.— Same tree in August.



Fig. 15.—All laterals cut.

Enough has been said, however, to show that *Acacia Catechu* is not only capable of taking a lac infection at a very early age but also that the crop obtained is of considerable value from more than one point of view.

Lac grown on *Acacia Catechu* differs in one respect from that grown on other hosts, and this difference is most noticeable after the crop is cut, that is to say the lac appears to be very brittle. This may be due to the fact that the sticks shrink rapidly after cutting. When used as brood the sticks need very careful handling as the incrustations tend to come away from the sticks very easily. As suggested above this may be due to the shrinkage of the stick on drying as certainly after a few days of being cut it is quite possible to rotate a complete incrustation round its parent stick.

The above peculiarity however has its merits also as if the crop is to be sold as scraped lac, the cost of removing the incrustations from the stick is considerably lessened, and these as a rule may be twisted off with the fingers, instead of by the more laborious method of scraping off with a knife as is generally necessary with lac grown on other hosts. This brittleness is also a disadvantage if it is desired, when using it as brood, to tie branches into the tree to be infected, but owing to the fact that *Acacia Catechu* is a thorny tree this process can be considerably simplified by lacing the brood sticks into the new host tree. This also has the advantage of saving labour charges.

From reports received from Sabaya it would appear that in a good season *Acacia Catechu* may be expected to produce a heavier crop per area of tree than its competitor *Schleichera trijuga*. The incrustations are uniformly longer and more regular in size than those of *Schleichera trijuga*. This is only natural when the structural growth of both trees is studied. *Acacia Catechu* produces long straight branching shoots up to 10-12 ft. in length shortly after pruning, whereas *Schleichera trijuga* produces shorter shoots sometimes only six inches long from the end of a thick branch, the latter being covered with a tough bark quite impenetrable to the proboscis of the lac insect,

After a few more seasons' working it will be possible to review the facts more fully and state the results which may reasonably be expected from the use of this tree as a lac-bearing host.

SUMMARY AND CONCLUSIONS.

Acacia Catechu of the family Leguminosae has been shown to be an excellent host for *Tachardia lacca* in Ranchi District for the following reasons:—

1. It germinates well from seed.
2. It is an extremely rapid grower and is capable of taking an infection two years after being sown as seed.
3. It responds very well to pruning and trees pruned in April-May put forth excellent succulent shoots, often as long as 10-12 ft., for infection in the following July.
4. Brood lac obtained from it alternates well with that from *Schleichera trijuga*.
5. Lac produced as the result of this alternation is pale in colour and both as stick lac and as brood lac now fetches the same price in the local markets as pure *Schleichera trijuga* lac.
6. Incrustations are good both as regards thickness and length.
7. As far as trials have proceeded yield figures have been extremely good, and compare well with those obtained for *Schleichera trijuga*.
8. The lac obtained on *Acacia Catechu* is brittle on the stick and little scaping is required. This, however, is a disadvantage when using as brood and it is therefore better to lace lac-bearing branches into the tree to be infected rather than tie in the usual manner. As *Acacia Catechu* is a thorny tree the lacing method is quite suitable.



Photo by A. Rodger.

Taking the grips off the logs at dump.

9. *Acacia Catechu*, using the above alternation of broods, only gives one good crop per year, that is to say the one obtained in February as the result of a July infection.

It has so far been impossible to get it to produce shoots suitable for an infection in February.

MECHANICAL EXTRACTION AT CHENAT NAYAR, MADRAS.

BY C. S. MARTIN, CHIEF FOREST ENGINEER.

. This operation presents a situation where log extraction, if attempted at all, must be done by mechanical means.

The only good timber remaining in the forest lies at an elevation of from 1,500 to 3,000 feet above the plains. The topography is extremely rough, the hill sides frequently broken by sheer rock cliffs and masses of large boulders from old landslips. No export routes existed, so cart roads running up gradients as steep as 1 in 8 had to be constructed to the timber bearing areas. Slides or ropeways would not do as timber grew in small patches or in heads of valleys seldom exceeding 300—400 acres in each location.

With this brief preliminary description an account of the logging will be better understood.

As such cart roads in this type of country cost on an average Rs. 5,000 per mile, it will be easily understood that the amount of roads should be limited to the possible minimum. Therefore a cheap, easily portable logging engine that would reach out a considerable distance was necessary. Elephants were out of the question on account of the steepness of the hills and the size of the logs to be moved.

So a Twin-Fordson powered, three drum skidder was purchased and mounted on a strong sled 40 feet long. This operates over a maximum haul of 1,800 feet and an additional 200 feet may be reached by the use of tag lines. It may be operated

either as a tight or slack line machine. The cost erected on the ground was Rs. 23,000.

The operation as shown in the photographs accompanying the article is by the sky-line system. Along an over-head rope of $1\frac{1}{4}$ " diameter stretched between a head and a tail situated 1300 feet apart in this particular instance, a travelling carriage operates, controlled by the main and haul-back lines. This carriage is run out over the line, a 20 feet cleared strip through the forest, at a speed of 750 feet per minute. It is then lowered to the logs to be yarded by slacking off the haul-back line. On each trip out it carries the chokers used on the in-going logs, which, while one turn of logs is going in, are affixed to the next logs to be yarded. Therefore it may be attached quickly to the log about to be taken. On the 'go-ahead' signal, given by a shrill whistle, the main line tightens up, raises the log off the ground, and hauls it along the overhead line at a speed of 150' to 250' per minute. During this inspection one log of 140 c.ft. was yarded.

The side radius of each yarding haul is about 150 feet, so to the head tree, in a forest producing an even stand of timber, there will be a succession of strips 20' wide with intervening strips of forest of 300 feet. Little damage is done to regeneration except along the 20' strips. Along these, as the humus and soil are stirred up and exposed during the operation, natural seeding takes place readily, protected by the side shade of the forest on either side. It can therefore be used as a type of strip system of regeneration.

With a timber stand of not over 400 c.ft. per acre of saleable timber to be removed, the cost of assembling logs along the cart roads, using a petrol engine, is about $2\frac{1}{2}$ annas per c.ft. With a steam skidder and a heavier yield of timber this cost decreases rapidly, and with efficient operation can be brought down to 6 pies per c.ft. in a forest yielding 20 to 40 tons per acre.

In the operation indicated, felling and cross cutting the timber with saws costs 5 pies per c.ft.; yarding to cart road $2\frac{1}{2}$ annas; carting down an average 1 in 10 gradient 7 miles, and along a metalled road another 8 miles costs 4 annas; roads cost



Photo by A. Rodger.

Heavy log arriving at dump.

2 annas. Therefore the logs are delivered at the sawmill, 15 miles away, at an actual cost of approximately 9 annas per c.ft. The over-head costs vary with the outturn, local conditions, and the form of accounts maintained.

The direct supervision of the operation is entrusted to subordinates who have gradually become skilled in the work. One Ranger builds and maintains all roads, arranges and pays transport, and has general control of the entire labour force. A Forester has charge of the machine and the actual yarding. The direct control of the operation is under a Forest Engineer, Mr. E. S. Dawson, who belongs to the cadre of Forest Engineers in the Indian Forest Service. It is due to his energetic and competent technical supervision that the operation has reached its present efficiency.

It may be mentioned in passing that this machine may be moved anywhere under its own power from a 1 in 2 slope up or down. It was recently moved about 5 miles over as difficult country as is often met with.

**THE EAST KHANDESH FOREST DIVISION, BOMBAY
PRESIDENCY.**

Situation.—The Division is situated on both sides of the Tapti river and is bounded on the north by Indore and Nimar States, on the south by Hyderabad State, on the east by Bhopal State and the Central Provinces, and on the west by West Khandesh and Nasik Districts. The Satpuda hills run along the northern boundary of the Division.

The Division is 100 miles long from east to west, and on an average 50 miles broad from north to south. The G. I. P. Railway runs through it from west to east, branching at Bhusawal into two lines, one running to Nagpur and the other to Jubbulpore and Delhi. At Jalgaon the Tapti Valley branch of the B. B. & C. I. Railway joins the G. I. P., coming south-east from Surat. From Pachora a narrow gauge railway runs to Jamner, one of the

Taluka towns of the District. These railways are of little value to the Division from a forest point of view, in fact rather the reverse, as large quantities of good quality timber are imported by them, which has an adverse effect on the sale of the home grown timber, which is for the most part of very poor quality.

Climate.—The climate is of the typical Deccan nature, hot and dry with a rain fall of about 22" in the hills and 28" in the

February is extremely bracing, and on the higher parts of the Satpuda Hills frosts are common.

Geology.—The underlying rock system is Deccan trap, of the amygdaloidal or softer variety, which disintegrates rapidly. Interposed between these layers of trap are often found sedimentary beds of calcareous shale, chert, gravel, and red bole.

The soil resulting from the disintegration of these rocks is very variable both in depth and fertility. Red or brown sandy loam of universal dryness, and often very stony, and of little depth prevails generally on hill slopes. In such soil the characteristic growth is of inferior deciduous species, such as *Boswellia serrata*, *Anogeissus latifolia*, *Odina Wodier*, and stunted teak. Black cotton soil is found in patches throughout the forests, but this being apt to become water-logged in the monsoon, and to crack into deep fissures in the hot weather, does not support a good crop. In the river and nalla valleys, however, where it is mixed with alluvium, it produces a good crop of good quality timber of the best species.

System of management.—The forests in the Division are divided into four main blocks:—

- (1) The Satpuda Hills.
- (2) The Edalabad extension of the C. P. Hills.
- (3) The Satmala forests on the hills bordering on Hyderabad State in Chalisgaon Range of this Division.

- (4) The Scrub Jungles, occurring in numerous small isolated patches in the middle of the cultivated lands all over the plains.

Each of these has a Working Plan, that of the Satpuda Hills being the most important. It is divided into three Working Circles, the Anjan Working Circle, the Teak Pole Working Circle and the Teak Timber Working Circle. The system of management in the first two is coppice with standards on a 30-year rotation for the first and a 45-year rotation for the second, and improvement fellings for the third.

The Edalabad and Satmala forests are both *anjan* (*Hardwickia binata*) forests, and are also worked under a system of coppice with standards on a rotation of 30 years.

The Scrub Jungle Forests have recently been brought under a new Working Plan, under which the growth is cut over on the coppice with standards system with a short rotation, and the grazing is subjected to a system of periodical closure, by which all the grass in the forest is allowed for grazing each year, but by opening various sub-blocks during different months each year, each sub-block is allowed to seed once in every four years.

The chief revenue of the Division is from grass and grazing, and it is therefore on the nature of the monsoon that the size of the surplus depends. In a good monsoon, there is plenty of fodder in the fields, and the demand for grass and even for grazing becomes very small. In a bad monsoon, there is urgent demand, and the prices run high. This to the same extent balanced by the fact that in a good monsoon money is plentiful, the people do a lot of building, and the coupes sell well, while in a bad monsoon money is tight and the coupes sell badly.

The demand for fuel has fallen off deplorably of recent years owing to the adoption by nearly all the cotton ginning and pressing mills of coal instead of wood for fuel, and the coupes of the *anjan* Forests find very little market now-a-days. An obvious solution of this difficulty would seem to be the preparation of

charcoal and sending it to Bombay, but there are two difficulties in the way, which are possibly insurmountable. One is the distance of the forests from the railways, and the other is the shortage of water. The latter might be surmounted by doing all the felling and collection of the fuel during the dry weather, and the burning just after the monsoon when there is water in the nallas.

Forest settlements.—A system of forest settlements has been in operation for many years in the Satpuda forests, and other settlements have recently been formed in the Edalabad and Satmala Anjan Forests.

There is a keen demand for land in the forests and the system consists in giving out groups or settlements of 50 10-acre plots in suitable places to members of the more jungly tribes, such as Bhils, Pavras and Tadvis. This forms a very useful in forest population for putting out fires and generally carrying out forest works. The settlers pay a nominal assessment and get many privileges in return for which they have to remain in the settlement the whole year round and perform the duties of a forest villager, and they are held under an agreement by which they can be evicted at a moment's notice for failure in any of their duties.

Roads.—During the last four or five years an extensive road programme has been carried out and construction is now nearing completion. These new roads tap hitherto inaccessible forests, and besides substantially increasing the revenue, make touring the Satpudas a much easier matter than it was before.

Shikar.—The Division is a good one for shikar, and though large bags of small game are not to be expected anywhere, I can think of no camp in the Division where the pot cannot be kept going by an hour's stroll each evening.

Tiger, panther, and bear are plentiful, chiefly in the Satpudas, and in the Edalabad forests, and sambhar and chital of the very largest size have been shot in the Division. Black buck

1930]

TIGER TREE

21

and chinkara are plentiful in most of the camps and barking deer and four-horned antelope all over the Satpudas.

As the rivers in the forest itself dry up except for small pools in the hot weather only very small fish are obtainable in them, but in the Tapti and Purna rivers large murrel and fresh water shark are obtainable. The former are also available in one or two of the larger pools in the Aner river in the Satpudas.

J. L. BELL I.F.S.

A TIGER TREE.

Until I come across this *Anogeissus latifolia* tree I had never paid much attention to tiger scratches on tree trunks in the forest. They are not uncommon. In some instances it looked clear that the tiger had done no more than stand erect and claw the bark with forepaws at the level of his head or thereabouts in the manner of the domestic cat. Tigers in Southern India also climb trees with the object presumably of escaping from man or from a pack of red dogs, or a sounder of pig or perchance from an angry she-bear, or again it might be as an aid when hunting although leopards are more prone to that.

On November 11, 1929, I was out in Sanivaram R.F. of Vizagapatam District with the District Forest Officer, Mr. Matthew and Ranger C. S. King on a trial trace for a bridle path. We came across this *Anogeissus* tree, deeply scratched by a tiger. This species is notably smooth-barked and this specimen was particularly so. The tree was the tallest and biggest in the vicinity, with a straight clear bole free of branches and the scratches went a long way up so I thought the matter worth looking into. What excited our interest were the questions:

(i) How high did he climb?

(ii) Did he climb to the first lofty branch?

(iii) If not, how long did he hold an insecure and uncomfortable position *vis-a-vis* that straight smooth bole?

(iv) Why did he select the most difficult tree to climb?

(v) Did he finally jump in order to descend, no matter what the height?

(The forest villagers were positive he jumped).

We returned next day. The height of the tree is about 90 ft. and the girth is 4 ft. 1 in. at breast height. Out of a party of 8 men and boys none would attempt the climb; certainly it was about as difficult as possible, so we cut a bamboo and lashed it to the stem and sent a man up in that way. The height to the first branch is 37 ft. 9 ins. The scratches extended to 32 ft. 6 ins., and about 2½ feet below that a slight swelling of the bole would give some small support to the tiger's hind quarters. The girth there was measured as 3 ft. 7 ins. I doubt if he could hold the position there for very many minutes, say half an hour at most. There was not a trace of a sliding descent so we concluded his jump was about 32½ ft. less 2½ ft. equals 30 ft. That is a good jump. In the process of examining the bole for traces of the descent we saw at once that the tree had been climbed by a tiger before! The old marks were plainly seen up to about 16 ft. and I dare say they extended higher. I may mention that there were trees closeby, much easier to climb, a tall rosewood (*Dalbergia latifolia*) 13 feet away, branchy, rough barked and seemingly easy and a smaller rosewood about the same distance from the *Anogeissus*, particularly easy to climb and hide in, so we were left to wonder why the *Anogeissus* was chosen twice. By a coincidence, later in the day we found another *Anogeissus*, girth 4 ft., very similar to the tiger tree in form, and that had been climbed twice by some animal which we deduced to have been a large jungle cat. The last climb had been to a height of 16 ft. Finally a *Xylia* tree adjacent (about 20 ft. away) had also been climbed by a similar animal. To summarise it looks as if *Anogeissus* bark gives just the right "grip" for a climbing feline and none of them mind straightness of bole. After a preliminary straight piece they go up in a spiral. A tiger can jump with ease and safety probably from any height which a cat can.

We were able to narrow down the dates between which the tiger made the last ascent as between October 8 and November

6; he had certainly not been molested by man. There are wild pig in the forest and I saw their rootings within half a mile of the tree. They may have treed him or it might have been wild dog of which I saw a solitary dropping about $2\frac{1}{2}$ miles away. The tiger must have felt sure he was not viewed by his pursuers and I imagine he held his position on the stem only long enough to let them pass by unknowing, underneath. But why not choose a tree which would give some cover?

J. H. LONGRIGG, I.F.S.

PRIZE-DAY AT THE FOREST COLLEGE, DEHRA DUN.

The annual prize-day for the Indian Forest Service Class was on the 30th October 1929, and the Inspector General of Forests made the following speech :—

“Gentlemen,

This is the second prize giving for the Indian Forest Service College which has been held at Dehra Dun and it is the last which will be held at Chand Bagh.

The results are better than last year and all the students have qualified, though none have obtained Honours. At one time we were disappointed with the work being done but recently the standard has improved in nearly all cases, and I am pleased to see that there were no failures. One student has won three prizes and has thoroughly deserved them. The athletic record of the class now leaving is poor, and we should have been pleased to have seen much more keenness in games. In the annual sports it was disappointing to see what a small part the I.F.S. students took, with one brilliant exception. We feel that the I.F.S. probationers should take much more interest than they do in the general life of the College, including athletics.

The first class for the I. F. S. started work here in 1926 and already we are going to lose our College buildings. Government has decided to hand them over to Medical Research and we expect to leave Chand Bagh altogether very soon. The policy of

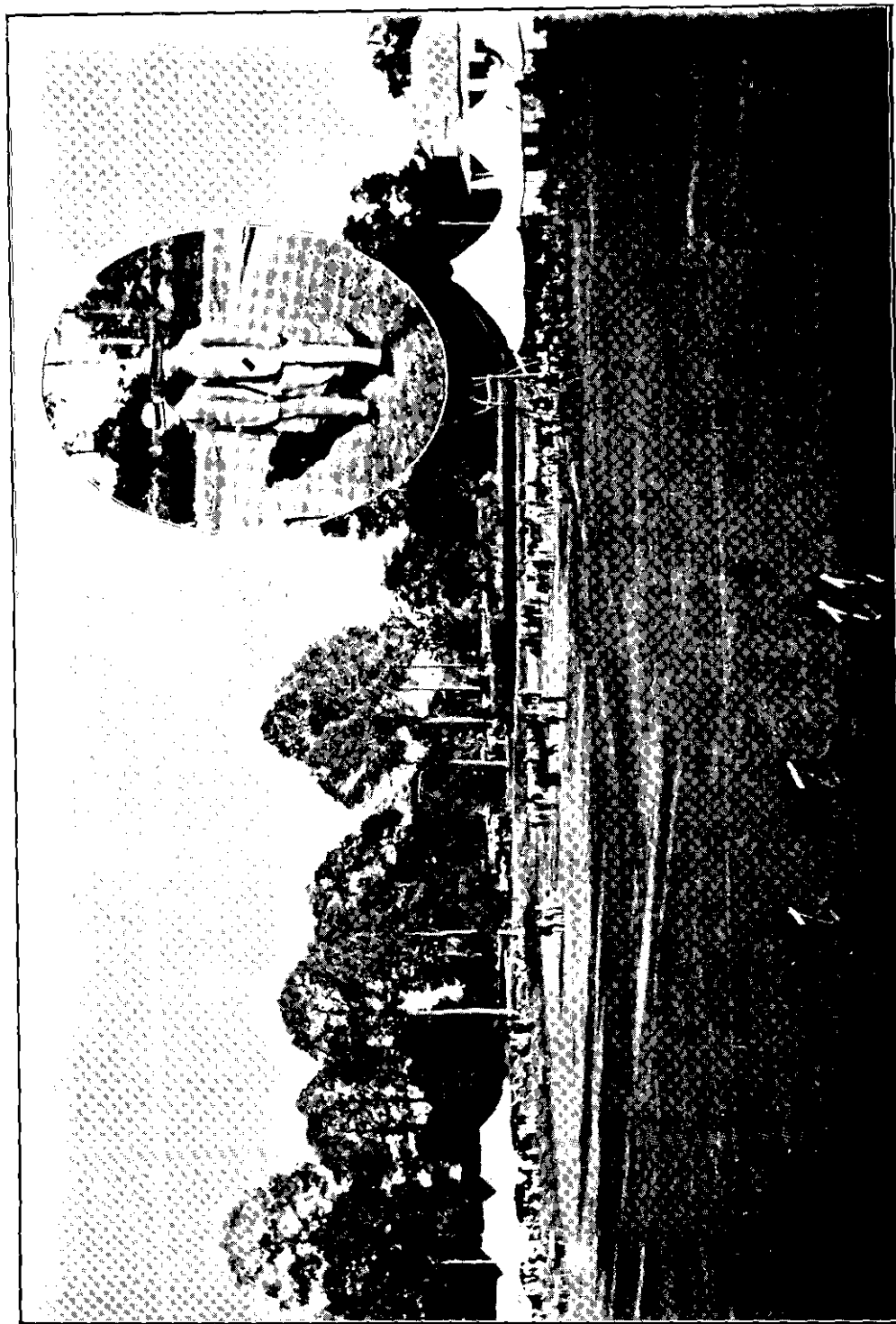
the Government of India with regard to the training of probationers for the I.F.S. has not been easy to carry out because of the small number of students that have come to the College. The provinces have asked for very few probationers and we have not yet had any student from the Malay States, Ceylon and other parts of the Empire as we had hoped. The result has been that the number of students has been very small and that some of the amenities of an ordinary college have not been available. We hope for better things in the future but a great deal will depend on the report of the Statutory Commission and the attitude of the Provinces as regards the training of their probationers.

It is now proposed to move the I.F.S. College to the new Forest Research Institute where there are very good rooms available, and we shall probably build a hostel for the students there later on, though nothing has been decided about this yet.

The probationers who are now leaving the College should remember that they are joining a service which has traditions second to none in India. The success of the Indian Forest Department in the past has been due to the fact that the officers of the department have lived most of their lives in their forests and have made them their homes. Forest work cannot be done by sitting in an office, however clever the forest officer may be. Subordinates are quick to respond to encouragement and personal example and on the training of Rangers and Foresters a great deal of our success has always depended. Remember too that forestry is not a rapid profession. You must be content that others should reap the fruits of your work. You are leaving Dehra Dun to take your share in managing an area of a quarter of million square miles of Government forest and I am sure that if you do your best, you will find that you have chosen one of the finest professions in India.

It is unfortunate that Mr. Trevor, to whom is due the credit for organising the College during its first years, is again not with us. He took the greatest interest in the College and to him and to Mr. Simmons and Mr. Trigg and the rest of the staff I offer my best thanks.

ATHLETIC SPORTS AT THE FOREST COLLEGE, DEHRA DUN.



General view of the Annual Sports and (inset) His Excellency Sir William Malcolm Hailey, Governor of U. P. with Mr. A. Rodger, Inspector General of Forests.

The result of the examinations is as follows, and I have much pleasure in distributing the diplomas and prizes :—

Order of Merit.

1. Tasdiq Hussain ... Government Probationer.
2. Awadh Narain Bhatnagar ... Ditto.
3. Ram Lal Khajuria ... Kashmir State.
4. Kunwar Shiv Pal ... Mandi State.
5. Bishamber Nath Zutshi ... Kashmir State.
6. Rameshwar Sahai ... Government Probationer.

The three Government probationers have been posted by the Government of India as follows :—

Tasdiq Hussain to the Central Provinces, Awadh Narain Bhatnagar to Assam, and Rameshwar Sahai to Madras.

Prizes.

- Hill Memorial Prize for Silviculture... Ram Lal Khajuria.
- McCrie Memorial Prize for Management Ditto.
- Hon'ble Member's Prize to Best Practical Forester Ditto.
- "Indian Forester" Prize for Botany... Kunwar Shiv Pal.
- Prize for Surveying and Drawing ... Awadh Narain Bhatnagar.
- Prize for Zoology Tasdiq Hussain."

FOREST COLLEGE SPORTS AND "AT HOME."

The College held their annual sports at Chandbagh on the 29th October, 1929. The events were keenly contested by the Ranger students, but we regret to say that the I.F.S. class did not shine as athletes and showed very little interest in the races.

There was a large gathering which included His Excellency the Governor of the United Provinces and Lady Hailey who presented the prizes to the winners.

The results were as follows :—

Marathon Race :—(Approx. 7 miles).

1. Ghazanfar Ali (Time 47 Min. 27 Sec.)
2. Atta Elahi.
3. D. N. Kharyal.
4. Ram Lal Khajuria, (I.F.S.).

100 Yards Race :—

1. Ghazanfar Ali (Time $11 \frac{8}{10}$ Secs.).
2. Ved Brat Singh.

Long Jump :—

1. Jamal-ud-din (17 ft. 4 in.).
2. P. D. Stracey, (I.F.S.).

Half Mile Race :—

1. Ghazanfar Ali (2 Min. 15 Sec.).
2. S. N. P. Nautiyal.

High Jump :—

1. Khan Mohamad (4 ft. 9 in.).

Throwing the Cricket Ball :—

1. Alam Singh (89 yds. 1 ft.)
2. Khan Mohamad.

220 Yards Race :—

1. Ghazanfar Ali ($25 \frac{7}{10}$ Sec.).
2. Jamal-ud-din.

Junior Staff Race :—

1. Peroo.
2. Shanker Singh.

Quarter Mile Race :—

1. Ghazanfar Ali (57 Sec.).
2. Jamal-ud-din.

Weight :—

1. Khan Mohamad (30 ft. 2 in.).
2. Ghazanfar Ali.

Low Hurdles—220 Yards. :—

1. Ram Lal Khajuria (31 Sec.) (I.F.S.).
2. Jamal-ud din.

Senior Staff Race :—

1. N. C. Karr.
2. G. S. Rana.

Relay Race—One Mile :—

Forest College *versus* Royal Indian Military College.
Won by the Forest College team—

1. Jamal-ud-din.
2. Ram Lal Khajuria, (I.F.S.).
3. Ghazanfar Ali.
4. Ved Brat Singh.

Mile Race :—

1. Ghazanfar Ali (Time 5 Min. 20 Sec.).
2. S. N. P. Nautiyal.

Obstacle Race :—

1. Khan Mohamad.

The Championship Cup was won by Ghazanfar Ali.

THE ORISSA STATES' FOREST SCHOOL.

Although the Feudatory States of Orissa occupy a little known and undeveloped tract of country, their position with regard to forest administration is not as backward as might be expected. They possess a total of over 6,200 square miles of reserved and almost 400 square miles of protected forests, out of which no less than 2,563 square miles are under regular working plans ; and further plans are in the course of preparation.

However, probably the most prominent feature of recent development is the newly founded Forest School at Champua in Keonjhar State. The scheme was made financially possible by the liberality of the Ruling Chiefs, who generously donated Rs. 43,000 to the cost of the buildings and equipment.

The school was founded with the object of providing training for foresters and deputy rangers in the Feudatory States on the lines of the existing Bengal Forest School at Kurseong. The development of forest management in the States was being greatly hampered by the lack of trained men in these grades, and the number who were being annually trained at Kurseong did little more than replace casualties. It became, therefore, yearly more evident that unless some separate training centre was provided, the necessary number of trained staff would never be obtained.

In 1927 the first move towards the formation of the present institution was made, and a class of thirteen students underwent a course of eight months' training under very adverse conditions owing to lack of suitable accommodation. Still, the results achieved in the first year were felt to justify the creation of a permanent school, and this proposal met with the full support of the Chiefs. The buildings were started towards the end of 1928 and were completed and fully equipped by the end of September 1929 the course being extended to ten months.

One obvious advantage of having the school situated within the province is that the instruction is imparted under the same conditions as will be met with by the students when they return to their respective States. In this connection the Government of Bihar and Orissa has been good enough to allow the practical work of the school to be carried out in Saranda Division which is easily accessible from Champua the headquarters of the school. Tours are made in Keonjhar State in addition, and it is hoped that it may be possible in the near future to arrange for visits to some other Government forest divisions in the province and to some of the more advanced States of the Agency.

The 1929-30 session will be marked by the deputation of four Government candidates, since the school has been recognised by the Government of Bihar and Orissa as the provincial training centre for foresters, in place of Kurseong. That the provincial school should have been initiated by the Feudatory States is perhaps somewhat unusual.

The buildings consist of the instructor's quarters, the students hostel and the main school building. The latter contains one large classroom, a museum, a small library and a herbarium. Accommodation is provided for twenty students, but a regular class of eighteen is aimed at. Four seats are reserved for Government candidates, leaving fourteen for distribution amongst the States, *which number twenty-six. Applications for seats from other private forest owners in the province are also expected.*

The curriculum is on the lines of that followed at the Bengal Forest School.

H.F. MOONEY, I.F.S.

[The forests of the Orissa Feudatory States' occupy over 6,200 sq. miles of Reserved Forest and nearly 400 sq. miles of Protected Forests. Government Forests in Bihar and Orissa amount only to 1,799 sq. miles of Reserved Forest and 1,271 sq. miles of Protected Forests. Although management is certainly more backward in the States than in the Bihar and Orissa Government Forests, it is not so backward as may be imagined. All the States have a forest conservancy staff and most or all follow some kind of working scheme. To help the Chiefs in managing their forests an Indian Forest Service Officer is lent by the Bihar and Orissa Government as Agency Forest Officer to be an adviser in all forest matters. He draws up Working Schemes and Plans for the States, checks and controls leases, conservancy and management.

Helped in this way, the Feudatory States enjoy an annual revenue of about Rs. 23,63,196 compared to Rs. 9,95,912 from the Government Forests of Bihar and Orissa. Encouraged by these results and spurred on by the Agency Forest Officer who impressed them with the necessity of a trained staff, the Chiefs have given money to found and maintain a fully equipped Forester's school in Keonjhar, one of the Orissa States which lies immediately to the south of the Saranda Forest Division. This shows that the Orissa Ruling Chiefs show a keen appreciation of the need of proper forest management and of a trained subordinate staff, and is an encouraging result of the work of the Agency Forest Officer during the past few years.—Ed.]

NOTES ON SWISS WINTER SPORTS.

1. THE TIME TO GO.

The ideal time is January 15th to February 15th. Within that period one is fairly sure of good snow and ice at every real centre. The further outside that period the more necessary it is to choose the higher altitude centres. In 1927-28 there was very little snow at Wengen until about January 10th and a first temporary thaw occurred about February 20th. Daily weather reports from most well-known centres appear in the London newspapers.

2. THE PLACE TO GO.

The writer can only venture an opinion on the following places which are arranged in approximate order of expense (cheapest first):—

- (1) *Grindelwald*—very moderate; specially good skating ice because it lies in a deep hollow and gets little sun, which, however, is a definite disadvantage in other respects; a good ski-ing centre with access by cog railway to Scheidegg, except that the top-most stretch of about 2 miles is closed by excessive snow in winter and must be walked. Some people go there year after year and swear by it. It is definitely cheaper than most places with similar facilities.
- (2) *Wengen*—a most excellent place with exceptionally good rail access to higher points from which one can ski back without having had to climb on foot. Very sunny and magnificent scenery.
- (3) *Scheidegg*—two stations above Wengen on the cog railway up the Jungfrau. A high altitude place with good snow earlier and later in the season than Wengen; hence a good selection for a Xmas holiday. It is a small place with only two hotels but they appear to offer just about as much indoor amusement as the larger places. Sun all day long, being on a saddle between two valleys. Superb

scenery. Splendid ski-ing. Skating. For tobogganing one would have to go down towards Wengen and return by train.

- (4) *Mürren*—on the opposite side of the valley from Wengen and Scheidegg. Rather the centre for the expert ski-er, intent on racing. Less sun. Splendid local practice runs but not so good for longer excursions as Wengen.
- (5) *Adelboden*—said to be a good place for easy ski-ing. Probably the climbing must be done on foot, there being no cog rail to the usual runs.
- (6) *Kandersteg*—specializes in ice hockey.
- (7) *St. Moritz*—dressy and expensive.

3. HOTELS.

Get the hotel guide from the Swiss Federal Railways Office, London. Roughly speaking, the greater the number of rooms the more expensive and the less friendly the general atmosphere. If one is with a self-sufficient party a large hotel may be very nice. If one is alone or with only a small party then a moderate sized or small hotel is better. The Park Hotel, Wengen, is a first rate place of moderate size. Almost all hotels have central heating, speak English, feed one extremely well and are clean. Many have an official indoor amusements organizer, *e.g.*, a British officer convalescing who gets special rates in return for his services. Hot baths are extra but most visitors get their money's worth by sniffing at the benighted foreign custom of charging, forgetting the price of wood fuel in the Alps.

4. COSTS.

At the Park Hotel, Wengen, the cost is about 27 shillings a day, completely inclusive (*i.e.* hotel, hire of skis, guides, etc.). Probably £1 to 30 s. per day is the usual range. Family parties sharing rooms probably work out a little lower still. All prices, including tips and guides' fees, are clearly fixed. There is a definite per cent. on the bill collected by the hotel office and

distributed to all employees. Outside that there is no need to tip except for any really out of the way services.

5. TRAVELLING.

The following are recommended :—

First class on the steamer.

First class on the continent by night.

Second class on the continent by day.

A sleeper costs a lot extra and is not worth the money. A "couchette" costs little extra and is worth the money. It is possible to return from Switzerland comfortably and moderately by travelling 1st without sleeper by night to Paris (train may be half empty) and day service from Paris to England. On the cog railways it pays to buy books of tickets for repeated ski-ing run trips.

6. KIT.

- (1) *Boots*.—Both ski and skating boots can be hired in Switzerland. Ski boots are rather better and slightly cheaper in Switzerland than in London. It is essential to have them fitted by an expert. They must be big enough to wear two thick pairs of socks and still be comfortable.
- (2) *Socks and stocking*.—Better and cheaper in London than Switzerland. Same applies to woollen things in general, *e.g.*, sweaters, scarves, etc.
- (3) *Bedford cord riding breeches*.—These with puttees are worn quite a lot and are very serviceable. Best bought in London. Practically all the ladies wear trousers and no skirt. In these days one scarcely misses the latter.
- (4) *Waterproof Norfolk jacket*.—A moderate priced and serviceable type is available in Switzerland. Necessary if there is much wind or if one is going on a long excursion to high altitudes. Otherwise a sweater with suitable inner clothing is adequate.

(5) *Ski-ing suits of gabardine, etc.*—A complete suit, *i.e.*, jacket and baggy Dutch trousers of windproof material, is probably the most comfortable and practical dress. They are somewhat expensive but the girls look very fetching in them. London nicer and dearer. Switzerland not so nice but cheaper.

(6) *Etceteras.*—Glare goggles cheap and adequate in Switzerland. Mits, with one finger detached, London, or Switzerland Balaclava with ear flaps, London.

Woollen gloves to wear beneath the mits, London.
Skis, skates, sticks, toboggans etc., are best hired in Switzerland.

7. THE SPORTS THEMSELVES.

Ski-ing is by far the best of the lot, but it is the most exacting. An average male under 40 should be able to learn enough to enjoy himself hugely on skis in 10 days. An average female under 40 in 10 to 20 days. A boy or flapper from the word go. After 40 much depends on weight, muscle, condition, etc. Some discretion is advisable. Don't be disheartened by the experts. It is not quite so impossible as it looks. Study the beginners who most nearly resemble you in age, weight, etc., and then decide calmly whether you can endure the apprenticeship of nose-diving and upending. The most moderate skill will bring immense satisfaction and is worth much tribulation.

One commends very warmly the elementary book on how to ski by Caulfield. It is sound, very clearly written and illustrated and well worth buying and studying. It can be bought in London or Switzerland. There is a more advanced book by the same author which should not be confused with the elementary volume. Lessons are expensive and helpful but not essential for everyone. The writer got on quite decently without them, thanks to Caulfield's book. For the beginner at Wengen one recommends a first week on the nursery slopes, a second week

on the Scheidegg-Wengen runs and thereafter the Mannlichen-Grindelwald and other delightful excursions.

Skating is well catered for but one cannot pretend to be enthusiastic about it in comparison with ski-ing.

Tobogganing or lugeing is good fun and is less exacting than either ski-ing or skating. Discretion is still advisable, however, as it is possible to break a limb if one disregards icy track conditions, etc.

Curling has an enthusiastic following of people who are not so young as they once were.

Once a week there are usually excellent ice hockey matches or ski-jumping competitions by Swiss experts who are well worth watching.

The trip by cog railway through Wengen and Scheidegg to the Jungfrauoch, some 10,000 ft. up the Jungfrau should not be missed. It is essential to choose a clear day in order to enjoy the marvellous views. The hotel porters are good judges of weather.

See also Winter Sports Annual by post one shilling and two pence from Cecil Palmer, 49 Chandos St., London, W. C. 2.

C. W. SCOTT, I.F.S.

REVIEWS.

ANNUAL REPORT, FORESTRY SERVICE, GOVERNMENT OF PALESTINE, JERUSALEM, 1928.

The report is not printed but has been issued on foolscap typewritten. It contains 30 pages of report and twice as many pages of appendices. The following extract from the report will give some idea of the work that is being done in Palestine:—

“Events during the year have tended to bring the local importance of forestry into greater prominence. The ultimate dependence of agricultural and horticultural progress on the conservation of soil and water, now wasted in prodigious quantities is generally admitted and it has also been recognised that these indispensable factors can only be economically secured by recourse to forestry measures. An independent expression of opinion on this subject may be found in a very definite pronouncement made by “Joint Palestine Survey Commission” in the following statement:—

‘The importance of a systematic policy of afforestation throughout Palestine cannot be exaggerated. It would not only

favourably influence the climate and afford protection to the water supply, but it would render possible eventually to utilise the hill sections of the country which are not now available for agriculture and thereby provide a new source of revenue. It is believed that the extension of such a policy is likewise a function of Government and it is hoped that the Palestine Government will seriously consider this subject.

Private enthusiasm for forest planting, which had suffered some set-back during the recent financial crisis, has also been generally revived, that movement being much stimulated by the Balfour Forest Dinner at the Guildhall in London and the subsequent inauguration ceremony in February of the Balfour Forest at Ginegar. Much interest too was displayed in forest lectures recently delivered by the Director of Agriculture and Forests to the Palestine Economic Association and to the Government Arab College and proposals are now under consideration for the formation of a Palestine Forestry Association.

The appendices attached to this report refer to the period from the 1st of October, 1927 to the 30th of September, 1928. Statistical information has been improved by the inclusion of fresh data and by the introduction of new features. Appendix No. 26 for example represents a first attempt to determine the incidence of grazing by right-holders and "stangers" cattle in forest reserves, while appendices dealing with the extraction of produce and the revenues realised reflect in greater detail the exploitation of both forest reserves and private forests.

Progress in constituting forest reserves has been considerably less than in previous years owing to the pre-occupation of the staff with other duties and was restricted to the proclamation of 27 small forests with a total area of 12,968 dunams.

Planting operations were seriously affected by exceptionally unfavourable weather. The rains failed generally in December, 1927, planting schemes had to be suspended, and funds were lost through lapsing of the credits at the end of the financial year. In 1928 late rains were insufficient to carry plants through the normal summer drought and considerable mortality resulted. A novel feature was the introduction of afforestation works in relief

of unemployment. The credit for this purpose was opened at the end of December and, though much useful work in the way of soil preparation and terracing was accomplished, late planting and the lack of rains resulted in a large percentage of failure.

Forest conservation is dependent to a large extent on the awakening of a forest consciousness among all sections of the community. Much may be done in this direction by propaganda and the projected Forestry Association should be in a position to afford material aid. Meanwhile the number of forest contraventions, while testifying to the activities of the junior ranks of the Service in bringing offenders to book, is considerably higher than that reported from a number of other countries. Procedure introduced during the year empowering senior officers to compound offences is proving effective and saves much time by obviating the need for constant attendances in Court.

Forest Demarcation and Survey has been confined to the Northern Circle. The appointment of a second Forest Surveyor long overdue, should be possible early in 1929 the necessary technical equipment having now been ordered.

The enactment of Forest Legislation, details of which are given in Appendix I, calls for little comment. A short amending ordinance providing powers to compound offences and to licence retailers of forest produce was promulgated. The main ordinance of 1926 continues to operate satisfactorily in most respects. Notable exceptions are the inadequate powers for ensuring the protection of privately owned woods and plantations, and the failure to provide for the determination and record of forest rights and servitudes.

Forest revenues have increased by approximately LP. 400 and are capable of still further expansion. A remarkable feature is the proportion derived from privately owned property. Departmental "Sale of Forest Produce" appears as a new item which may be expected to increase as working plans are introduced and departmental plantations reach exploitable age. The progressive increase in Revenue from LP. 2812 in 1921 to LP. 8224 in 1928, despite the withdrawal of some LP. 1000 per annum earlier obtained from quarrying licences, is worthy of note.

Exploitation has been conducted as previously entirely by licences. Production of firewood and charcoal has proved sufficient to meet all local requirements, notwithstanding an embargo on export of these commodities from Syria and Trans-jordan. Prices have been maintained at a low level with some tendency to fluctuate with changes in the price of kerosene. Small timber for domestic requirements has also been supplied from forest reserves, but requirements of sawn industrial timber continue to be met by expensive importation from abroad with the single exception of small quantities of locally grown *Eucalyptus* wood. Possibilities appear to exist of an export trade in charcoal with Egypt and of developing the production of charcoal as a carburant.

Little advance has been made during the year in Forest Management and the lack of progress in this direction is the most unsatisfactory aspect of the forest programme. Beyond some extensions to the annual coupe system forest reserves have been worked under rough and ready methods with inadequate regard to technical requirements. Progress in the introduction of working plans has been limited to the completion of a few detailed stock maps. This unfortunate state of affairs is ascribable primarily to the inability of officers to spend the time required in the field and also to their lack of technical experience.

In the matter of research, there are indications of sustained improvement although the lack of trained observers and inadequate facilities for recording results are serious drawbacks. Among important items may be mentioned sand-dune reclamation, experimental methods of countering soil erosion, the introduction and trial of exotic species, nursery technique, and the collection and identification of indigenous species.

The Forest Service has undertaken as an additional duty the initiation of a sericultural industry, an export instructor having been appointed for this purpose. Local possibilities have been widely explored and the necessary propaganda set in motion. The first practical measures in connection with the propagation of mulberry plants on a large scale are referred to in the text."

**FOREST ADMINISTRATION REPORT OF JAMMU AND
KASHMIR FOR THE FASLI YEAR 1984-1985 ENDING
30th ASSOJ 1985. (15th October, 1928.)**

The year under report has been a record financially, the surplus amounting to 48½ lakhs as compared with 42½ during Fasli year 1983.

The report makes interesting reading. It is illustrated with excellent photographs.

CORRESPONDENCE.

NOTICE—Correspondents who wish their letters to appear in a particular number of the *Indian Forester* should ensure that they reach the Honorary Editor by the 15th of the previous month with a request to that effect.

SAL AND ITS REGENERATION.

SIR,—I was very interested to see Mr. Osmaston's letter of September 19, published in the November *Indian Forester*, and particularly his evidence that where deer are negligible e.g., in the Singhbhum Divisions, sal regeneration is excellent. This confirms the observations made by Mr. Collier in Nepal where Nepalese and Tharus have practically exterminated the deer and Mr. Collier states that inspite of annual fires the sal regeneration everywhere is excellent. A few days ago I was going through one of the sal regeneration areas in the Haldwani Division and in about an hour I counted 10 sambhar, 21 chital and several kakar. In the hot weather when the grassy savannahs in this Division have been burnt and young green grass is coming up, it is possible to go out any morning or evening in April and May and see 200 to 300 heads of deer grazing in the open. The Haldwani Division evidently affords a striking contrast to the Singhbhum Divisions!

Mr. Osmaston hopes that some valuable information will become available on the natural regeneration of associates of sal and mentions particularly *haldu* (*Adina cordifolia*). On this point we already have some interesting results to record. In the Haldwani Division generally *haldu* regeneration is conspicuously

EXTRACTS.

AN INDIRECT METHOD OF MEASURING THE AMOUNT OF FOLIAGE ON DIFFERENT BLOCKS OF TREES.

R. A. TAYLOR, B.Sc.,

Physiological Botanist, Rubber Research Scheme (Ceylon).

The method to be described has been carried out successfully in estimating the effects of various manures on the foliage cover in rubber and can be used to obtain a measure of the effect produced by spraying or manuring against leaf diseases of rubber.

The amount of shade under the trees is estimated by comparing the depth of tint obtained when pieces of photographic day-light printing paper are exposed for known lengths of time, the depth of tint being inversely proportional to the amount of shade and consequently to the density of the foliage cover.

It is essential that the light should be uniform throughout the period of measurement and that the sun should be overhead. The observations should, therefore, be made between 11.30 a.m. and 12.30 p.m. on a bright cloudless day. To obtain a proper estimate of the average depth of shade the observer should, while making the exposures, keep moving at as uniform a pace as possible through each plot as there are always patches of bright light and dense shade in the plots.

To minimise the effect of possible variations in the different sheets in each package of printing paper it is advisable to make one exposure in each block on the same sheet. To enable this to be done a printing frame 12 ins. by 10 ins. fitted with a sheet of plain glass is used. A well-fitting wooden screen is supplied for this frame and held in position by four catches. In this screen a number of circular holes one inch in diameter are bored and are closed by rubber bath plugs. The printing paper is inserted behind the glass in the usual way.

When an exposure is to be made the plug bearing the number or letter of the block of trees to be tested is removed and the arranged time of exposure measured by a stop watch. The plug is replaced immediately on expiry of the period. Well-fitting plugs are essential for success. When all exposures have been made the printing paper can be fixed in the same way as an ordinary photographic print and a permanent record is obtained.

With Ilford P.O.P. mauve, one minute exposures have been found to be suitable and the following procedure for fixing is recommended :—

Wash in running water	5 minutes.
Fix in 15 per cent. hypo	10 „
Wash in running water	2 hours.

To obtain a numerical value for the depth of tint a series of standards has to be prepared. On the frame used by the writer there were 25 holes allowing 25 exposures to be made without the necessity of changing the paper. The frame was laid flat on open ground at 12 noon and one plug removed every two seconds. When the last exposure had been made the frame was covered and taken to the laboratory and the exposed printing paper fixed by the method described above. The tints on this standard sheet were numbered 2-4-6-8, etc., and were used for comparing the tints obtained by exposures made under the trees. It was found that the tints obtained by exposure to direct sunlight were not exactly the same as those obtained under partial shade. For this reason it is preferable to prepare

the standard in ordinary light which should be of uniform and constant intensity during the period of the exposure. Periods of longer duration than two seconds should then be employed. The values obtained have no absolute meaning but provided the exposures are carefully made the results obtained would in the writer's opinion be capable of statistical examination.—(*Tropical Agriculturist*).

CINCHONA IN THE EMPIRE.

INDIA'S POSITION.

"India, the only cinchona producing country of consequence other than Java, makes no attempt to supply the needs of other parts of the Empire. She, in common with the rest of the world, looks to the Dutch plantations in Java to aid her in her misfortune."

The statement is contained in a report on the progress and prospects of the cultivation of cinchona in the Empire by Mr. J. H. Cowan.

Comparing production in India and Java, says Mr. Cowan it has to be admitted that, starting about the same time and with abundant opportunity in both countries Java now produces well over 90 per cent. of the world's supply of cinchona bark and India only about 4 per cent.

SERIOUS DEFICIENCY.

"Such a situation can scarcely be regarded with equanimity. In actual fact, the deficiency is much more serious than is shown even by the figures already given, for the quantity of quinine purchased at a very high price in no way represents the real need.

"Sir Patrick Hehir, I.M.S., in a recently published book on Malaria in India, estimated that, for India alone, the lowest amount of quinine which would have any effect upon the malaria problem would be about 970,000 lbs. This estimate is based on a consumption of only 20 grains per head per annum, and those of us accustomed to our 5 grain pill per day will at least acknowledge that this is not an over-estimate.

"The total consumption in India is about one-sixth of this figure, so that, were India to be in a position to provide for merely her own minimum requirements, she would immediately have to increase her production by 18 times. It is obvious then that not only is there very great scope, but also very great need, for an increased production of cinchona and at the same time for a reduction in its selling price.....

"Quinine with which to ward off malaria or to effect a cure is at present offered at the high figure of £1 9s 6d. per lb. and supplies are insufficient for extensive anti-malarial measures to be taken.

"The affected millions are thus caught within a vicious circle, and part of the effect of this state of affairs is revealed in the death-rate from malaria.

In India in an ordinary year some 1,300,000 people die of this endemic disease.

"The time has come when further concerted efforts must be added to those now being made to face these problems. One of the first steps and an exceedingly important one is to increase the production of cinchona and quinine. It is here that the forest officer can assist and advise and be instrumental in terminating the present impasse."—(*Statesman*.)

THE INDUSTRIAL POSSIBILITIES OF WATER HYACINTH.

By GILBERT J. FOWLER, D.Sc., F.I.C.

(Principal, Harcourt Butler Technological Institute, Cawnpore.)

My attention has been drawn to the article on this subject by my friend Mr. A. T. Weston, Director of Industries, Bengal. I am rather sorry in the first place to note the tone of Mr. Weston's reference to those problems which, he states, emerge and disappear as topics of the hour. The inference would seem to be that they are of no real moment and need not upset the complacency of responsible people. The problems he mentions are the Howrah Bridge, the silting up of the Hooghly, the drainage of Calcutta and the numerous menaces to public health, the tragic possibilities of which are only too well realised by the zealous officers of the Public Health Department. Every one of these is and has been for long a crying scandal and a blot on the good name of Calcutta. With resolute and imaginative leadership backed by enlightened public opinion and civic pride they would have been successfully met and handled years ago. Such qualities, however, are far to seek in any country and in Calcutta it is to be feared that lack of progress is due not so much to the inherent difficulties of the situation as to simple ordinary inertia combined with the influence of vested interests and politics.

Mr. Weston's opening paragraph would indicate that he is a victim of what Mr. Winston Churchill in his volume on Gallipoli speaks of as the 'No' thought. The trouble about the "No" thought is that those who are possessed by it are very alert to difficulties but quite blind to possible means of overcoming such difficulties. It is for this reason that Mr. Henry Ford in his last book "To-day and To-morrow" writes as follows :—

"It is not easy to get away from tradition. That is why all our new operations are always directed by men who have had no previous knowledge of the subject and therefore have not had a chance to get on really familiar terms with the impossible. We call in technical experts to aid whenever their aid seems necessary but no operation is ever directed by a technician, for always he knows far too many things that can't be done. Our invariable reply to "It can't be done" is, "Go, do it."

I myself had much experience of the "No," thought in the early days of the Activated Sludge process. I received little or no encouragement from the *pandits* of Victoria Street and the initial risk was taken by a business man of vision, the late Mr. Walter Jones of Stourbridge. After he had pulled the chestnuts out of the fire the orthodox engineers became interested.

For these reasons I am not too perturbed at Mr. Weston's observations on my hitherto quite preliminary suggestions with regard to the possible utilisation of water hyacinth for the production of power. It has taken many years to make a practical success of the utilisation of the gas from sewage sludge. Now, apart from the results in Birmingham to which I drew Mr. Weston's attention, and which he describes in his article, the process is so far developed at Essen that at one works alone more than 21 million cubic feet of gas were delivered into the town mains during the year.

In considering any large technical project the first thing to do is to find out whether it is possible; the next thing is, is it practicable? That the evolution of power gas in adequate quantities by the fermentation of water hyacinth is possible can hardly be doubted and also that weight for weight more is likely to be obtained from it than from sewage sludge. Ordinary sewage sludge contains as a rule about 50 per cent. inert and useless mineral matter, of the organic matter only a portion is fermentable cellulose. A typical ash content of water hyacinth is 24.2 per cent. (Finlow and McLean, Pusa Bulletin No. 71, 1917) and the organic portion consists mainly of starch and easily fermentable cellulose. Consequently the comparison which Mr. Weston draws between Birmingham sludge with 8 per cent. of solids and water hyacinth with 5 is fallacious. Moreover, there is a point which Mr. Weston has completely ignored, *viz.*, the valuable proportion of potash present, in certain cases up to 30 per cent. of the ash, or even 11 per cent. of the total dry weight of the plant. Prof. H. K. Sen has shown how this potash can be extracted in a pure form by quite simple methods. In any process for the utilisation of water hyacinth this potash content must be recovered.

Already the results obtained by Messrs. Finlow and McLean in Dacca have shown the value to agriculture of the potash in water hyacinth. Mr. Howard, in an article in Capital of June 18th, 1925, also suggested methods by which water hyacinth can be converted into valuable compost.

The recovery of potash or the production of compost presupposes the collection of the water hyacinth and its accumulation at different centres. This Mr. Weston dismisses as the snag on which utilitarian schemes have come to grief. It is here that I would suggest that a little less of the "No" thought would be of advantage since in Florida it has been found quite possible to employ barges and grapples to collect the hyacinth. Mr. O. J. Wilkinson states, in a paper on Water Hyacinth (*Indian Engineering*, September 29th, 1928), that a channel 4 miles in length and 100 feet in width was cleared by hand labour for an expenditure of Rs. 2,000

and that for five years since it has been kept clear by a patrol of only two coolies. Mr. Wilkinson states that they could be employed for a much greater area just as effectively. Such costs would be surely recovered simply by the increased value of the water-ways. The recovered water hyacinth is of the nature of an asset to be set against the cost of such patrol works. Here a continuous and far-sighted policy would have to be adopted by Government itself and in the light of information, obtained in the first place by a systematic survey, it should be decided what centre or centres would be economically most suitable for the utilisation of water hyacinth along the lines suggested by Prof. Sen and myself.

Whatever site was finally selected no one would surely seriously recommend, and certainly I have never recommended, the proposal outlined by Mr. Weston to cover an area of 20 acres 3 feet deep with floating gas-holders. Apart from the obvious economic objections to such a scheme from the point of view of constructional engineering the result would simply be as Mr. Weston himself indicates, that the whole area would shortly cease to be productive of water hyacinth and also of gas. Obviously the proper procedure would be to construct tanks of the type of the Imhoff tanks at Essen and feed in the water hyacinth after having extracted the potash by the Sen process. It might be possible to arrange for floating gas-holders to be moved from point to point, but this would seem more troublesome and costly than collection of the water hyacinth.

It is quite true that cellulose fermentation needs careful control if it is to be efficient. There is, however, no lack of young chemists in Bengal who are quite competent to look after such plants and would be thankful to have the opportunity.

The real crux of the matter is whether the photo-synthetic solar energy will produce sufficient water hyacinth in a given time to develop an economic amount of power gas when the resultant cellular tissues are subjected to the biochemical activities of anaerobic organisms. That is a question at present under investigation at the Harcourt Butler Technological Institute. If the results are favourable it would point to an extraordinary possibility of direct conversion of solar energy into power without the intervention of any drastic methods involving high temperatures or costly and corrosive chemicals, a method highly suitable for such a country as India. Simultaneously the same solar activity will be as it were engaged in the collection of potash for the use of Bengal agriculturalists.

It has for these reasons seemed to me that if Prof. Sen's figures of cost for the production of power alcohol by the fermentation of the water hyacinth are anywhere within the region of possibility the production of power gas by direct fermentation would surely be an even better proposition.

Mr. Weston himself appears to have a lurking misgiving since he says, supposing its successful utilisation can be demonstrated, the weed would at once assume an economic value. This is the crux of the question. How

often in the history of technology has the stone which the builders rejected become the head of the corner, the waste product become the main asset! If this should be so in the case of the water hyacinth, the difficulties to be encountered will be more administrative than technical and there will therefore be plenty of ability available to deal with them.

(*Capital*, 12th September, 1929.)

BROTHER TO THE BIRDS.

A SANCTUARY IN ONTARIO.

(*The Miner Gospel*).

The supplementary estimates of the Federal Government of Canada which were tabled on May 31, contained a modest item of \$3,000 grant to the Bird Sanctuary of Mr. Jack Miner. It was properly passed without a dissenting voice. Behind this vote lies the story of the lifework of a humble Ontario farmer who has constituted himself a guardian of wild life in Canada, and has been labouring assiduously, by example and by precept, to convince his countrymen that the unregulated slaughter of wild birds and beasts is a social crime and that their judicious preservation will produce a variety of generous dividends.

Jack Miner is the son of English parents who migrated from Leicestershire in the middle of last century to a farm in Ohio, where he was born in 1865, the second of a family of 10 children. Formal schooling was not vouchsafed him, and he was actually 33 years of age before he could read or write. His boyhood was spent on the Ohio homestead; he was set to work at a tender age at farm tasks and also learnt the rudiments of the art of hunting from his father. But the Miner farm being unfertile yielded a miserable living, and so in 1878 the family migrated to Canada. They acquired a free homestead in Essex County, at Kingsville on the shores of Lake Erie, some 25 miles south-east of what is now the thriving city of Windsor. The county forms the westernmost tip of Ontario, with Lake Erie to the south and Lakes St. Clair and Huron to the north, and 50 years ago it was so thinly settled that it abounded in game of all kinds, particularly in waterfowl, which were attracted by the adjacent lakes. Mr. Miner senior and his sons combined with their farming activities the making of bricks from a claybed on their land, and young Jack had his full share of arduous toil. But in the mornings and evenings he was constantly afield with his gun. Several times, too, he had an opportunity to shoot moose and larger game in the northern hinterland of Ontario.

FIRST TO BE TAMED.

Even in his early boyhood Jack Miner had begun to take a keen interest in the life and habits of wild beasts and birds, and the enthusiasm of the naturalist gradually overcame the sportsmen's zest for slaughter. "They had to tame me first before I could think of taming them," is one of his sayings. His first experiments in the conservation of wild life took

the form of the erection of rude shelters of brushwood and the provision of grain for the coveys of bobwhite quail, which he found to be faring poorly in the hard winters. His next effort was the raising of ringnecked pheasants. Then he discovered that flocks of the magnificent wild fowl known as the Canada goose were in the habit of resorting every spring, for a rest on their northward journey to their breeding grounds in the Arctic, to some small ponds caused by the excavations for clay for the bricks. He had secured heavy bags of these beautiful birds before he was attracted by their intelligence and character. He discerned that they were extraordinarily wary creatures, prompt to recognize him as a potential foe when he had a gun in his hand, and he argued to himself that, if they knew an enemy, they would also be capable of distinguishing a true friend.

So, after inducing his immediate neighbours to abandon indiscriminate shooting of Canada geese, he made with a little labour a good-sized pond in one corner of the farm, and in it, during the spring of 1904, put seven wing-clipped geese, purchased from an old farmer who had trapped them. They made the pond their home and wandered all over the farm, becoming remarkably tame; but the wild companions their owner expected them to attract did not appear. The springs of 1905, 1906 and 1907 went by, and Miner had to submit to a good deal of chaff from his neighbours. Then, one day in April, 1908, a boy ran in with the news, "The geese have come," and he found a flock had settled on his pond.

The neighbours, who had been promised that in return for their forbearance they would be given a chance to shoot geese at the proper time, hastened to claim the fulfilment of the pact, but Miner pointed out that, if they would only be patient and allow the geese to make the pond their temporary headquarters, they would become familiar with it, and even if some were shot the rest would probably return in the following spring. The local sportsmen complied with his wishes, and three weeks later he allowed them to kill a number of the wild geese. Six which survived the battle did not desert the pond, but remained until they took wing for the Arctic on May 1. Next spring Miner daily scanned the skies for evidence that his experiment had been successful, and on Sunday, March 18, he was delighted to see a string of 32 wild geese settle on his pond; the six guests of the previous year had brought back their young and some friends with them. Two days later Miner gave his neighbours a shoot, ten geese being killed and the balance allowed to escape. Next spring brought a much larger flock of geese, numbering nearly 400, and of these a modest bag of 26 was taken. March, 1911, found the geese arriving in huge flocks almost every day for three weeks. For their accommodation Miner had to dig a much larger pond and strain his resources to provide them with food.

THE WORK GROWS.

Two more years saw Miner's flock numbered by the thousand, and the geese had been joined by large numbers of wild duck of different kinds. As it was now impossible for their host to feed them with his own slender

stores of grain, the birds scoured the surrounding country in search of food. By this time Miner had become famous all over Essex and the adjacent counties, whose inhabitants made it a favourite Sunday excursion to drive to the Miner farm and see the waterfowl disporting themselves on the ponds. Some wealthy friends, realizing the value of the experiment, helped Miner with money and enabled him to extend it. At first he had been allotted only 10 acres of the farm for his birds, but now he turned the whole homestead into a bird sanctuary.

The Provincial Government of Ontario was next persuaded to help him. From it he secured thousands of evergreen trees and shrubs, which he planted among the native trees; more ponds were dug and encircled with sheltering groves; and planting has proceeded until what was an ordinary farm lacking any special features has become a delightful rural paradise. Moreover, the Government has proclaimed the whole of the adjacent country a wild bird sanctuary, within the limits of which heavy penalties are imposed on shooting.

The sanctuary seems somehow to have become known to the whole waterfowl world of North America, as there are few species which cannot be found on the ponds at some time or other. Most of the birds remain only for a few weeks in the spring or autumn, but a certain proportion stay as permanent residents. Indeed, some of the geese have become regular domestic pets, and Miner has many stories to tell of their almost human characteristics. In 1911 a large gander whose wing had been broken by a shot was unable to fly northward with his comrades, and another gander, quite unharmed decided to stay and keep him company. Named David and Jonathan, they became devoted friends and never left the Miner farm until some years later Jonathan came to a tragic end in battle with a vicious horned owl, leaving his companion almost inconsolable. Friendly purses have contributed regularly to supply provender for the birds and beautify the sanctuary, while the Federal as well as the Provincial Government is giving an annual subsidy.

Miner has made his sanctuary a base for experiments with waterfowl. By an ingenious trap he catches a number each year, and attaches to their legs tags inviting their slayers or captors to communicate with him. The resulting records show that tagged birds have been killed at widely distant places, ranging from the shores of the Hudson Bay to the estuaries of North Carolina, and have provided information about the migratory habits of the Canada goose and other birds. Apparently the geese at least fly in spring straight north from Kingsville to the Hudson Bay region, where they nest, and winter in the swamps of Virginia and North Carolina. Miner has helped to preserve that splendid bird, the whistling swan, from extinction; he has restocked Essex County with quail and induced woodcock, which had been unknown there for 40 years, to return to their old haunts. No kind of feathered creature, except crows, against which he wages relentless warfare, is denied a place in Jack Miner's affections. Birds seem to sense

that he is their protector, for waterfowl wounded miles away have been known to struggle back to his home and die almost at his feet.

Combining with the zeal of the naturalist a deep religious fervour, Miner has conceived also the idea of making his birds serve as missionaries of the Christian faith. Every tag he puts on waterfowl carries some scriptural text, such as "Keep yourselves in the love of God—Jude 1-21," and "With God all things are possible—Mark 10-27," and he derives peculiar satisfaction from the responses which are forthcoming. Nothing ever pleased him more than word from Arkansas that one of his texts found on a duck has been responsible for a religious revival in a "darkie" community, where a local preacher had interpreted it as a message straight from Heaven foretelling the imminent approach of the Day of Judgment.

"BACK OF JACK MINER."

Nowadays, with a sanctuary safely established, Jack Miner has betaken himself to propagandist activities for the conservation of wild life. Some years ago he began to lecture for the purpose of raising funds for his sanctuary and found appreciative audiences ready to listen to his descriptions of bird life which he illustrated with screen pictures. No trained, formal lecturer, he has developed a real gift for speaking in a simple, unaffected style; he unfolds his extensive lore of birds and beasts in homely, rural language, spiced with anecdotes. Lately he has started a crusade for a practical policy of wild life conservation, and from Kingsville there issues a steady stream of circulars and pamphlets expounding the Miner gospel and suggesting specific reforms which would promote it. He has also written a very readable little book.

His campaign helped to secure improving amendments of the Migratory Birds Acts of Canada and the United States; but he feels that these promise only a partial consummation of the policy which is his real goal. However, he has accumulated, both in Canada and the United States, a large body of sympathizers, who at different places have formed "Jack Miner leagues" to conduct vigorous propaganda for the creation of more wild bird sanctuaries and better protective legislation.

An excellent citizen of Canada is this gaunt, sun-tanned farmer from Essex County, who often says at the end of his speeches: "I have got nothing to boast of—back of old Jack Miner has been the powerful hand of the Unseen." At any rate, he has to his credit a work of genuine worth and distinction, and its fruits may live when the exploits of puissant politicians and captains of industry are forgotten.—(*The Times*.)

THE ELEPHANT CEMETERY.

IVORY TREASURE STORES.

By SIR WILLIAM GOWERS, GOVERNOR OF UGANDA.

Nobody knows exactly what the elephant population of Africa is, but it would be safe to say that it runs into hundreds of thousands. Yet it

is very seldom that a dead elephant is seen whose death cannot be accounted for either by shooting or some obvious accident, such as an animal missing its footing or breaking away the path on a hillside and crashing two or three hundred feet below.

Nearly a year ago I wrote a letter, which was printed in *The Times*, recounting the finding of a young elephant dead from natural causes so far as appeared; at any rate, there was no indication of any external violence. I hoped that some readers of *The Times* who had seen a similar thing would be able to suggest a probable cause of death, or at any rate might be able to say from their own experience whether the finding of dead elephants where human violence or accident could definitely be excluded was more common than I had supposed it to be. None of the readers of *The Times* whose letters with reference to this incident were published cited any parallel experience from Africa, and it is probably unwise to apply to the wild African elephant arguments or experience based on the Indian elephant (a different genus) generally observed when living or dying under unnatural conditions. I now have another experience to relate, and I am able here to supplement and support my account with photographic evidence, kindly supplied to me by Brigadier-General G. D. Rhodes, who took the photograph.

The scene of the photograph is the left bank of the Victoria Nile about six miles above the junction with Lake Albert and within a Game Reserve. When I first caught sight of the elephant I was on the deck of the sternwheel steamer Lugard on the way from Lake Albert to the Murchison Falls. We saw from a mile or two away an elephant which we thought at first must be alive, and it was only on closer approach that we discovered it was dead. It was an exceptionally large bull and completely tuskless. He had been dead probably for three or four days. His carcass was not yet sufficiently decomposed for vultures or hyenas and crocodiles to get through the hide. Of the crocodiles there were a large number congregated in the river close to the bank, evidently waiting till their game should have been "hung" long enough to be edible.

ELEPHANT OF RENOWN.

No bullet wounds were visible, and it was most unlikely that any European should ever have shot at this particular elephant, since he had no tusks. Indeed, it is probably only because he had no tusks that he was allowed to live as long as he did and to die eventually, as I think, of old age. Native hunting can be completely excluded from the possibilities. My friend Mr. Peter Pearson, now a game ranger in Uganda, who was shooting elephants on the Nile in what was then more or less the "No Man's Land" of the Lado Enclave 20 years ago or more, and was present on this occasion, tells me that he believes that this elephant was one that he had heard of and even seen in these parts in the "old days." This elephant was renowned for his large size, for being tuskless, and for his reputation for fierceness among the people who then lived on the east bank

of Lake Albert and the Albert Nile, an area now uninhabited owing to the removal of the population on account of sleeping sickness nearly 20 years ago.

I suspect that very few people have ever seen in Africa a large bull elephant recently dead without the evidence of any external violence. Mr. Pearson informs me that this incident is unique in his long experience as an elephant hunter. And this leads up to the question of how and where do elephants generally die? To start with, I think we may say that the death of a young elephant from natural causes is rather a rare thing. On the whole, it would probably be safe to assume that elephants live to about 100 years in a wild state in Africa. If this is so, and supposing elephants die only of old age, there would, if the total is estimated as low as 200,000, be 2,000 elephants to be found lying about in Africa every year. If there is any considerable mortality from disease the number must be much greater. The figure of 200,000 is a very low estimate. There are 20,000 elephants in Uganda alone, and I cannot believe that this small country contains 10 per cent. of all the elephants in Africa.

It may be thought that because one very seldom sees the remains of smaller game, buffalo, rhinoceros, etc., the disappearance of the remains of elephants is to be explained on the same grounds as the disappearance of the remains of other animals; but the skull and the larger bones of the elephant take a very long time to disappear, they are much too large and hard to be eaten by hyænas, and although they may be hidden in long grass for a long period every year they would always become visible after the burning of the grass if elephants died in open country. While in dense forests, where it could not possibly be assumed that all elephants die, their remains would be found on elephant tracks, the extent and width of which in forest much frequented by elephants has to be seen to be believed, and even if off the tracks they would probably not be hidden by such undergrowth as a very dense canopy of tropical forests permits to spring up.

AN EXPLANATION.

Many stories have been written about so called "elephants cemeteries"—places where it is suggested elephants go in order to die when they feel their end approaching. The idea makes a good story, but I think it exists only in the imagination of the story-teller. But there must be an explanation of the stories and of the fact that there is certainly evidence of the finding of a large number of remains of elephants close together. The explanation I suggest is that elephants almost always die in the water. When feeble, sick, or wounded, they have a special craving for water, in which respect they are not altogether dissimilar to human beings when sick or wounded. Moreover, healthy elephants in well-watered countries, such as tropical Africa generally is (at any rate those parts of it which hold large numbers of elephants), have a habit of going into water and bathing as often as they can. They like going into deep water and

standing for a considerable time totally immersed except for the tip of the trunk.

In the story of the elephant shown in my picture I think that the order of events was as follows. He was very old. Elephants, like men, may be presumed to go on doing the things they have been accustomed to do until *they suddenly find out that their hearts, or their lungs, or whatever it may be, will not stand it any longer.* The elephant, as he has no doctor to advise him on the subject, probably does not realize that his heart is not quite capable of standing the exertion he has been accustomed to put it to for the last 100 years. To this animal it may have seemed easy to cross the Nile where he did, but the effort of getting himself through the muddy bottom, and then making the last effort of hoisting himself up to about 6ft. to get from the bottom of the shallow water on to the bank proved to be too much for him and he collapsed and peacefully died. Probably he had no idea that he was in the least likely to die, or even that he was ill. He seemed dignified even in death, and I thought of the words, "Nothing is here for tears."

This elephant was an exception in that he had got out of the water and on to the bank before he died. I believe that elephants generally die in deep rivers, streams or swamps, and the papyrus swamps of the Nile and of Eastern equatorial Africa are so large and the papyrus so high that the dead bodies are never seen. In general the old elephant, or the wounded elephant, goes to the water every day, and as he is less inclined for going farther afield and searching for his food he remains near the water. One day, as his age and enfeeblement have increased, he is unable to pull himself out of the deep muddy bottom which most of these equatorial swamps and rivers possess, and he dies quietly in the water. In the water his skull and his tusks are subjected to less weathering than they would be if they lay on the surface of the ground, although even in these circumstances *ivory can remain in a fairly good state of preservation for a very long period.* It is quite possible that the stories of elephant cemeteries that one has read of are due to the drying up of some swamp to which elephants have resorted and in which they have died for many years.

MR. HORN'S STORY.

I recently found some confirmation of these suggestions in Mrs. Lewis's book "Aloysius Horn." Mr. Horn says, speaking of a man of a West Coast tribe:—

This old man told me that old elephants always had a favourite ogey or spring of clear cool water generally in a grove. The one I had killed would surely have made for one of these, which he thought was situated a little west of Lake Azingo, while a young elephant when badly wounded invariably died near the creek crossings or watering places he was used to as bathing and cooling resorts; not only that, but the younger elephants would be killed or badly beaten off if they approached the ogeys or springs resorted to by the rogue elephants, who were invariably chased off

from their herds when they were useless as breeders; the younger bulls would unite and chase him out. This, he said, he was doubly sure of. The old ivory, green and coloured ivory, was always dug up from around these places near a spring and was always full-grown ivory, while he could not remember finding any small scrivellos or female ivory in these ogeys. Thus I had what I think is the truth about the old story of elephants' burial-grounds. ("Aloysius Horn" pp. 115-116.)

It may well be that elephants dead from natural causes are more frequently found in Western than in Eastern equatorial Africa owing to the absence in the former of the impenetrable papyrus swamps which fringe so many of the lakes and rivers of the latter. This may account for the large stores of ivory found in the possession of native tribes (who in those days hunted only for meat and would be likely chiefly to kill young bulls and cows) during the early days of European penetration into the West African hinterland.

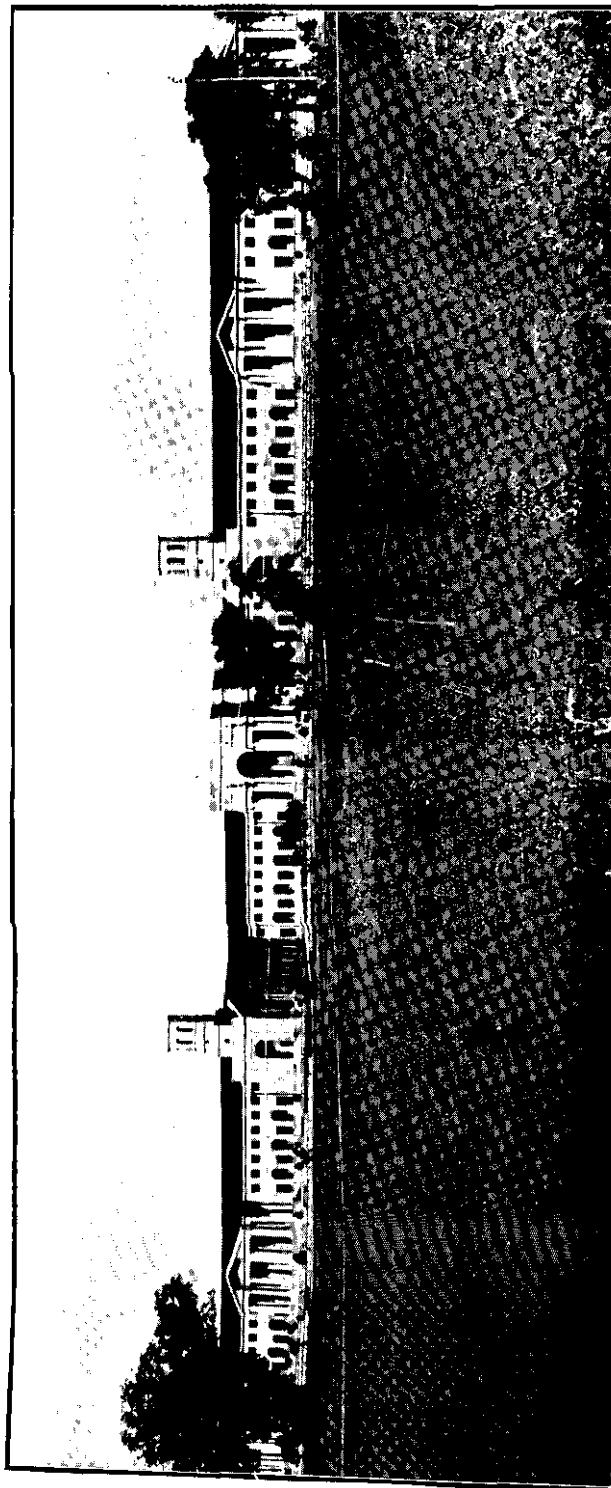
It is at least a possibility that under the actual bed of the White Nile, for several hundred miles below its exit from Lake Albert, and under the papyrus swamps along it, lie many thousands of tons of ivory. Perhaps the construction of a barrage across the Nile immediately below Lake Albert, which is part of the generally accepted programme of Nile control, may one day enable some further light to be thrown on the problem.—(*The Times*.)

DOMESTIC OCCURRENCES.

BIRTH.

Lambert—On 12th November 1929 at the Brunswick Square, Nursing Home, Penrith, to Mary, wife of W. J. Lambert I.F.S., a son.

OPENING OF THE FOREST RESEARCH INSTITUTE.



The Main Building.

INDIAN FORESTER.

FEBRUARY 1930.

COMMEMORATION NUMBER.

OPENING OF THE FOREST RESEARCH INSTITUTE,
DEHRA DUN, BY HIS EXCELLENCY THE VICEROY—
NOVEMBER 7TH, 1929.

November the 7th was a memorable day at Dehra Dun not only for the Forest Department but for all the residents.

His Excellency the Viceroy with Lady Irwin and staff arrived at the Railway station at 8-0 a.m., and at the Forest Research Institute at 9-30 a.m.

The main building and nearly all the subsidiary buildings and residences are now complete and the whole estate is well arranged and presents a very fine picture; avenues and groups of rare and beautiful trees have been planted and playing fields have been made. In front of the building and behind it are broad grassy terraces with facing walls of rough dressed stone. At each of the small staircases on the terraces two formal cypresses were planted four years ago. These have grown into handsome plants and set off the terraces well. Groups of shrubs bearing different coloured flowers, blue Jacaranda, pink Lagerstroemia, yellow Tecoma etc., have been placed along the front of the terraces and long lines of umbrageous figs have been planted running from the main building towards the principal gate on the Chakrata road, by which the Viceroy entered. On either side of the long straight drive are broad grassy stretches which

are for the present under the care of the Military Grass Farms Department.

As a fine decorative feature, we had, drawn up on the circular grass plot immediately in front of the main entrance, a Guard of Honour of the Black Watch with pipes and band. When His Excellency arrived he inspected the Guard and a procession was then formed from the main door to the platform in the Convocation Hall, consisting of Their Excellencies, the Secretary of the Department of Education, Health and Lands, the Inspector General of Forests and four of the Staff.

The Hall looked at its very best being decorated with large numbers of handsome chrysanthemums in pots. Seating accommodation had been arranged for about 450 guests, a number which just comfortably fills the hall. The audience consisted mostly of the civil and military residents of Dehra Dun, but the Forest Department was well represented, not only by the staff of the Institute and the College, but also by representatives of all provinces, Mr. Blascheck, Chief Conservator of Forests of the Punjab, Mr. Newman, Chief Conservator of Forests of Bombay, Mr. Richmond, Chief Conservator of Forests of Madras, Mr. Malcolm, Chief Conservator of Forests of the Central Provinces, Mr. Canning, Chief Conservator of Forests of the United Provinces, Mr. Cavendish, Conservator of Forests, Assam, Mr. Blanford, Conservator of Forests, Burma, Mr. Shebbeare and Mr. Homfray, Conservators of Forests, Bengal, Mr. Lyall, Conservator of Forests, Bihar and Orissa, Mr. Wright, Chief Conservator of Forests, Kashmir. The fine Burma teak panelling, designed like the rest of the building by Mr. Blomfield, sets off the architectural features of the hall in the best possible way. On the platform with Their Excellencies were those who accompanied them in the procession, as well as Mr. Mason, I.C.S., Superintendent of the Dun, Mr. Rouse, Chief Engineer, Delhi, and the five branch officers of the Forest Research Institute.

The speeches of the Viceroy and of the Inspector General of Forests will be found later in this number. After His Excellency had declared the Forest Research Institute open Sir

OPENING OF THE FOREST RESEARCH INSTITUTE.



His Excellency the Viceroy inspecting the Guard of Honour of the Black Watch.

Frank Noyce thanked him, and the party then visited the four principal museums where they were shown round by Messrs. Parker, Champion, Trotter and Beeson. After visiting the new library the party left the building at 10-45 a.m.

The remainder of the day was spent in shooting between Lachiwala and Kansrao, and good sport was obtained, thanks to the excellent arrangements made by Messrs. Marriott and Trotter.

Their Excellencies dined with Mr. Rodger at Forest Park and left Dehra by special train at 10-15 p.m. At night the contractors for the building gave a ball, and this brought to a close a most successful and memorable day. The large hall turned out to be in every way one of the finest dancing halls in India, and it will no doubt be in great demand in future.

The three most handsome rooms in the Forest Research Institute are the new library, in Andamans padauk, the large hall, all Burma teak, and the entrance hall, shisham and rosewood. Another room which is very effective is the office of the Forest Economist, which is panelled in poon (*Calophyllum*) from Madras. The other rooms are not so decorative, but, as Burma teak of good quality has been used throughout, they are mostly handsome as well as useful. A special feature has been made of the windows, with good lighting for laboratory work. The students of the Indian Forest Service College, who must now leave Chand Bagh, will be given lecture rooms in the upper floor of the west wing.

There are six museums, with floor space of 26,000 square feet, and the ordinary rooms designed for laboratories and offices cover about 63,000 square feet.

In the grounds, besides numerous residences of all kinds, are the offices and workshops of the Economic Branch which were designed and erected under the supervision of Mr. R. S. Pearson, now Director of the Forest Research Laboratories at Princes Risborough. The whole estate covers 1,200 acres, but 130 acres have been handed over to the Railway Board for

a training college, and 6 acres have been leased to a company who will provide electric current to the new buildings. A considerable part of the grounds is taken up by experimental plantations of chir pine, sal, and teak, and the Silviculturist, Botanist and Officer in Charge of Minor Products all have their experimental gardens. The old garden at Kaunli has been given up.

With the rapid improvement of the lawns and the growth of many handsome trees, it is expected that the whole estate will soon be as beautiful as Chand Bagh, which we are leaving with regret.

SPEECH BY THE INSPECTOR GENERAL OF FORESTS.

YOUR EXCELLENCIES, LADIES and GENTLEMEN,

As this is the first official ceremony that has taken place in our new buildings, I desire to welcome you all here and to say how grateful we are to Your Excellencies for having come up from Delhi to open the Forest Research Institute. We greatly regret that the Hon'ble Member, who had been eagerly looking forward to this occasion for several months past has found it impossible to leave Delhi. I am glad to say that we have with us to-day representatives of the forest service from every province in India and also from Kashmir.

Dehra Dun has been a centre for forest work since 1878 when a college was established for training Rangers and Foresters, and Forest Research here has been in close touch with forest education since the first Research officers were appointed in 1906, as they have always taken an important part in the training of the students.

The aim of Forest Research here has always been to work on lines which would prove of advantage, not only to the Forest Departments of all the provinces of India, but also to all users of timber and other forest products, especially the Railways and other large consumers of timber, such as Government Gun Carriage and Rifle factories,

OPENING OF THE FOREST RESEARCH INSTITUTE.



His Excellency the Viceroy and the Brigade Commander. *Behind* Her Excellency Lady Irwin and Mr. Rodger, Inspector General of Forests.

We have found it convenient to divide our work into five main heads :

Silviculture,
Forest Economy or Utilization,
Forest Entomology,
Forest Botany and
Chemistry.

Four officers of the Indian Forest Service and one specialist from outside were appointed to these posts in 1906 when the Institute first began to take shape, and the officers in charge of the five branches have been forest officers ever since, except in the case of the Chemistry branch, and for a short period in the branch of Entomology. A forest officer was also Chemist for a short time. The system of recruitment has been to obtain the forest officers on deputation from their provinces, and to engage specialists, formerly by selection from suitable candidates, and, of recent years, through the Public Service Commission.

Expansion of the work done in the five branches and increase of the staff has gone on steadily during the last 23 years. In four branches the increase has been small and gradual, but in the branch of Forest Economy, which deals with the utilization of forest products, particularly timber, the increase of work and of staff has been remarkable. The annual expenditure of the Institute is now over 7 lakhs of rupees. We employ at the Institute thirty-five gazetted officers, two hundred and twenty assistants and subordinates and three hundred and fifty men on daily labour.

Of the gazetted officers, nine are members of the I. F. S. and two are members of the P. F. S. The buildings in which the Institute has been housed have also developed on the same scale. In 1906 a few small isolated houses were used, but these were soon found to be insufficient and in 1914 a large building with laboratories was erected at Chand Bagh. It was expected that these would prove sufficient for many years to come, but the deve-

lopment of the forest resources of India made great strides during the War and every effort was made to render the country less dependent on foreign supplies. The Industrial Commission pointed out in 1918 the necessity for expanding the Institute to meet the rapidly increasing demands of the country, stated that the equipment provided was entirely inadequate, and emphasised the necessity for increasing the number of Research officers.

The Board of Forestry supported these proposals and the Government of India decided to acquire a large estate near Dehra Dun, to equip it with modern buildings and apparatus, and to strengthen the staff. The workshops of the Economic branch were completed and in working order in 1924, and the main building was occupied during the years 1926 and 1928. The cost of the new Forest Research Institute has been up to date about ninety lakhs of rupees, which includes a large number of residences of different classes, costing from Rs. 60,000 to Rs. 600. The main building was designed by Mr. Blomfield of Delhi and the work has been carried out by Sirdar Ranjit Singh. Our thanks are due to Mr. Rouse, Chief Engineer, Delhi Province and especially to Mr. F. T. Jones, Superintending Engineer, Delhi Province and to Mr. Uttam Singh, Executive Engineer, for the most successful results of their hard work of several years past. The buildings are now nearly completed, but a certain amount of extra work will be necessary, as Government have decided to give up the Chand Bagh estate to Medical Research. We are accordingly adopting part of the main building to the requirements of the training college for the I.F.S.

The results of the work done in the Institute have been made available to the public by the appearance since 1906, of about two hundred and twenty numbers of publications as well as a large number of educational and other works. It has always been the aim of the Research staff to put all the results of their work at the disposal of the public without delay, and this has been appreciated, judging by the demand for the publications, and by the continuous stream of enquiries that are received, not only from India and Burma but from every part of the world. For the inception of this fine project and for the work involved in carrying it

through, we have to thank principally three Inspector Generals of Forests, Sir Sainthill Eardley Wilmot, Sir George Hart and Sir Peter Clutterbuck. To Sir Sainthill Eardley Wilmot in particular the department owes a debt of gratitude for his far-seeing plans.

Among the distinguished forest officers who have received their initial training in Research here, I may mention Mr. Troup, now Professor of Forestry at Oxford, Mr. Stebbing, now Professor of Forestry at Edinburgh and Mr. Pearson, now Director of the Forest Products Laboratories at Princes Risborough.

In order that the work of the Institute should be reviewed and that guidance for future lines of Research on the most modern lines should be available, the Government of India appointed a small committee which visited Dehra Dun this year. These recommendations are now under consideration and will, if given effect to, materially improve the conditions under which Research is carried on. The committee have proposed among other things, that the powers of the President should be increased, that scientific direction should take a larger part in the work, that the method of recruitment of staff should be altered, and that greater facilities should be given to Research workers to come into intimate touch with work on similar problems in other parts of the world. For a scientific Institute like this, which represents research for the largest forest department in the British Empire, these advantages must be obvious and it is to be hoped that the recommendations of the committee will bear fruit and that the usefulness of the Institute to the country may be greatly increased.

I would now ask Your Excellency to be kind enough to open the Forest Research Institute of India. We feel that in doing this you are giving the final impetus to a work which is of vital importance to the development of one of the principal resources of the Indian Empire, which are as important to the peasant in his village as they are to the Exchequers of the Imperial and Provincial Governments, and which must always remain a most important concern of the Government of India.

HIS EXCELLENCY THE VICEROY'S SPEECH.

LADIES AND GENTLEMEN:

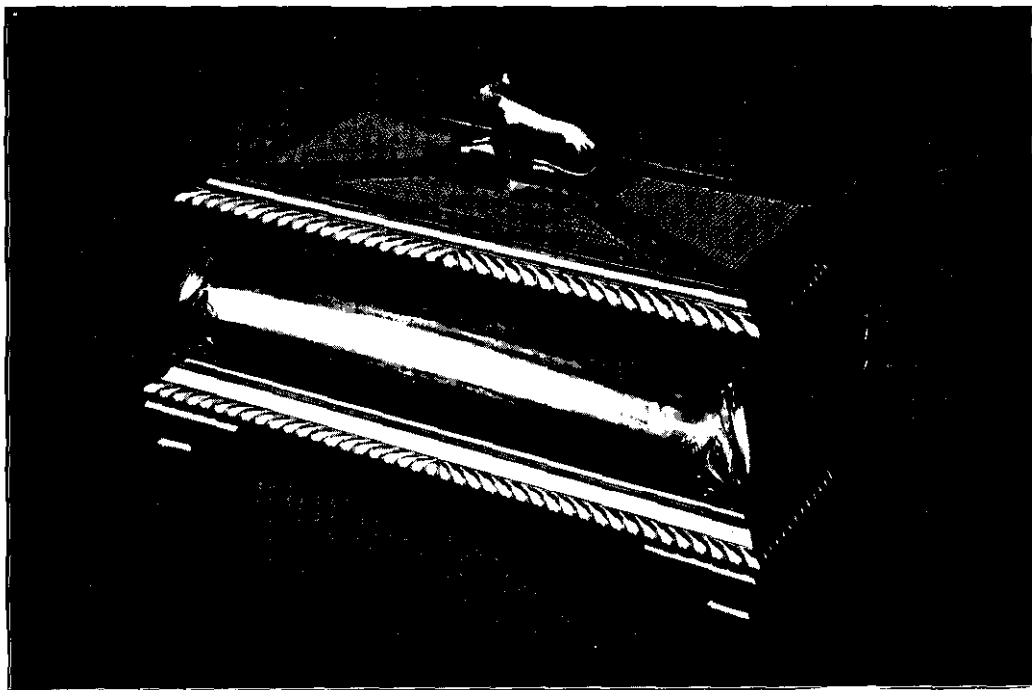
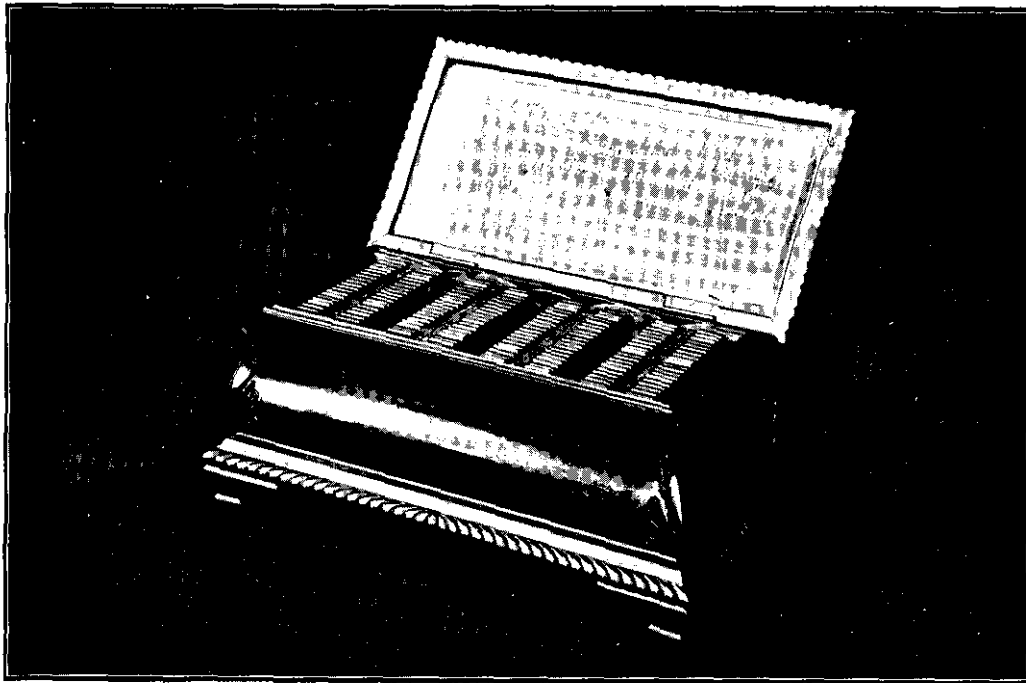
We have all listened with the greatest interest to Mr. Rodger's account of forest research in India and at Dehra Dun and of the inception and development of the Institute which I am to have the honour of formally opening this morning. It is an occasion of no small significance. This Forest Research Institute is, I believe, the largest and most complete in the British Empire if not in the whole world and its completion is an event in which India may well take pride. It is a very great pleasure to me, therefore, that I should have been given the opportunity of taking part in this ceremony. I remember that my first thought on seeing the layout of the Institute three years ago was that the building and their setting were in every way worthy of the great forests with which this country is endowed and of the fine work that has been, is being and is yet to be done towards their development and utilisation for the benefit of the people of India. And, now, remembering that the Indian Forest Department has to deal with nearly one quarter of the area of British India, that it makes an annual profit of nearly three crores of rupees and that it has such wide opportunities of increasing the prosperity of the people not only in the villages and remote tracts but also by the development of trade in commercial centres, I feel that those who have planned and those who have found the money for this Institute have been inspired by no unworthy conception of its potential value to the life of India.

RESPONSIBILITY.

Many of you have a much better acquaintance with the forests of India than I can claim but even in the journeys that I have performed up and down India and Burma, in hills and in the plains, I have seen enough of the country's wonderful wealth of forestry to realise the value of the trust we have in our keeping and our obligations to use it to the best advantage.

The control of our forests has, as you know, already been transferred in two provinces and it is quite possible that a similar development may before long be seen in other provinces too. But where an imperial asset of such value is concerned, my

OPENING OF THE FOREST RESEARCH INSTITUTE.



The Casket presented to His Excellency the Viceroy.

NOTE.— *This Casket contains 80 named specimens of Indian Timbers and was made in the workshops of the Forest Research Institute.*

Government have felt that a great responsibility will still rest upon them and they have, therefore, undertaken the financing and direction of forest research.

Research is the essential counterpart of the splendid work that is carried on from day to day and from year to year by the officers of the Indian Forest Service, often in face of danger and generally in that isolation which is a stern test of character and of devotion to duty. I feel no doubt that those whose part in the drama of Indian forestry will lie within the four walls of these buildings, will make the best use of the great opportunities afforded to them of assisting their service to achieve even finer results than India has yet seen.

WHAT IS THE USE?

I suppose the first question which anyone in this utilitarian age will ask is, of what use is all this research? What can the Institute actually show in the way of a dividend on all the money spent upon it. I confess that not long ago I asked Mr. Rodger the same question and he has been good enough, on more than one occasion, to give me some account of what has been done since the inception, in a small way, of the Institute in 1906. In the belief that it will be as interesting to my audience as it was to me, I will try and summarise something of what he has told me.

THE SILVICULTURIST'S BRANCH.

Take the Silviculturist's Branch. He is the medium by which information on silvicultural subjects is supplied to forest officers all over India as well as in other countries and he can by keeping in close touch with the problems of all provinces, and with the progress made in all parts of the world where forests are of importance, give invaluable help to enquirers from every forest division in India.

From the investigations of this branch, the owner of a forest, Government or private, can learn the age to which his trees can be grown so that the maximum interest on the invested capital may be realised and the manner in which the greatest

possible quantity of good timber can be produced. When planting a new forest the methods evolved at Dehra Dun, or evolved elsewhere and recorded at Dehra may save ten years in the time taken to form a plantation, giving a direct gain of nearly 25 per cent. in the present value of the crop.

The Silvicultural Branch can give and has given most valuable assistance in the afforestation of barren lands and I have little doubt that its aid will be called in to help the Imperial Council of Agricultural Research, now that that body has begun its work of improving the methods of the Indian agriculturist by showing how to establish fuel plantations to save valuable manure for the fields.

ECONOMIC SIDE OF RESEARCH.

Then comes the question of utilising the trees when they have been grown. Mr. Rodger has given us some account of the economic side of research and I propose only to supplement this by a few instances of actual results. Spars for aeroplanes, poles for gun carriages, stocks for army rifles, sleepers for railways, are all the subject of exhaustive research at Dehra Dun, and, thanks to that research, have attained a considerably higher degree of efficiency.

The Railways have saved many lakhs of rupees by employing modern methods of preserving second class woods so that they may be used as sleepers and large plants are now in operation in the Punjab and in Assam. The Government Rifle Factory at Ishapur will save nearly £10,000 a year by adopting the methods that have been worked out here of seasoning walnut for rifle stocks. The Railways are building seasoning kilns at Lillooah, being convinced by the result of the experiments made here that Indian timbers can be so treated and their value greatly increased. The Dehra Dun experimental work has also been embodied in the new seasoning kilns at the Gun Carriage Factory at Jubbulpore, where they are giving every satisfaction.

PAPER AND MATCHES.

After many years of work at Dehra Dun bamboos are coming into their own for paper pulp and two companies are now

being floated in London to work the enormous bamboo forests in Burma, the technical member of the board, being the pulp expert who has just retired from this Institute. It is expected that these two companies will be the forerunners of others which will work the extensive bamboo forests of India and Burma which are now standing more or less idle.

Another important question in India is the manufacture of matches from indigenous woods and, on the recommendation of the Tariff Board, proposals are now being considered for extensive experimental work and for a survey of the forests which contain potential match woods so that India may, as far as possible, produce all her own matches.

In other ways, too, such as in assisting the manufacture of turpentine oils from grasses, medicinal drugs, gums and other products, the Economic Branch has done work of the greatest practical utility and a continually increasing demand is being made upon them from every quarter for technical information.

WAR ON INSECTS.

In this Institute, too, incessant warfare is carried on against the insects and pests which affect the growth of forest trees and damage their timbers. Of all the injurious species, the heartwood borer of sal must, I think, bear the entomologist the heartiest grudge for its ravages on sal forests have, by the entomologist's efforts, been enormously restricted in recent years.

There was lately an epidemic in which it was found that no less than five and a half million trees had been destroyed by this borer, a loss of forest capital of approximately Rs. 138 lakhs. Thanks largely to the advice of the Dehra Dun Entomologist the control operations taken in hand to deal with this outbreak have been so successful that the attack has now almost abated and a loss of several millions of rupees has been prevented.

TRIBUTE TO MR. RODGER.

I have said enough to indicate to you the tale of romance and achievement which is being written here. For myself, I have been fascinated by what in frequent conversations with Mr. Rodger I have learnt of the possibilities which lie before

us and I only wish that I were competent to initiate you, as he has sought to initiate me, into the mysteries of botany, chemistry and mycology, which are conducted in their allotted rooms in this Institute. The work of these departments is indispensable to the success of our research organisation and to the economic utilisation of our forest resources.

But I have tried to give you some idea of what the Institute is doing. Nor have I time to refer to the valuable educational work done at the colleges allied to this Institute for the training of officers in forestry. The work done here, which owes so much to Mr. Rodger's own efforts and to the unceasing interest he and those under him have taken in making it worthy of their great charge, is of the very greatest importance and the construction of these buildings is cause for legitimate pride and satisfaction.

MEHTA COMMITTEE.

Buildings, however, are not everything. It was because my Government realised this fact that on the initiative of Sir Muhammad Habibullah, to whose interest and enthusiasm the Forest Department owes so much and whose presence here to-day has, to our great regret, been unavoidably prevented by the duties awaiting him on his return from his responsible mission to Geneva and London, they appointed recently, a small but expert committee under the presidency of Sir Chunilal Mehta to advise them about the functions and policy of the Institute and the future of its activities.

We are greatly beholden to the Committee for the valuable report which they submitted this summer and which was made public very shortly after it was received. In that report they made a number of most helpful suggestions and laid down, with admirable judgment and lucidity, the line of policy which should be pursued in the future. I am glad to have this opportunity of acknowledging our indebtedness to them.

Complete examination of their report must necessarily take time, but I am happy to be able to say that the bulk of their recommendations have already been taken up in consultation

with Mr. Rodger and that we hope to give effect, in due course, to very many of them. We intend within the limits of our financial liability to give this Institute, now so finely housed and located, the scientific staff which it requires and to omit or neglect no measure which we think will make for its continued success and greater usefulness.

INDIAN PERSONNEL.

The Institute, and the various allied activities of which it is the centre, must, as I see it, aim at the discharge of a double purpose. On the most effective utilisation of Indian woods, I have already spoken, but it is not less our desire to train Indian personnel in all the technical branches of forestry research work. The governing consideration must remain that of efficiency and I am certain no Indian, who is concerned to see this branch of India's resources fully developed, would be so short sighted as to desire the employment of Indians in any technical post just because they were Indians without regard to their technical qualifications. In research of any kind, reliable and accurate work is an absolute necessity. But subject to the maintenance of this technical standard, I yield to no Indian in my desire to see Indians filling an increasingly large place in the several posts that this Institute may have to offer in carrying out the policy which I have enunciated.

PROVINCIAL HELP.

The Government of India, I need hardly add, look forward to and most heartily invite the cordial co-operation of the Provincial Governments. The future success of the Institute must depend on the goodwill of the provinces and I fully recognise how much the work of the Institute can be furthered and how much more fruitful the results of its work for India are likely to be if their co-operation and support are assured.

My Government will welcome all the help that the provinces can give us in the work of co-ordinating forest research, and I feel confident that, as the years pass, the material gain to the country from the activities of the Institute so supported will be greater than, I venture to think, many of us here to-day can realise.

**HISTORY AND WORK OF THE BRANCHES OF THE
FOREST RESEARCH INSTITUTE, DEHRA DUN.
SILVICULTURE.**

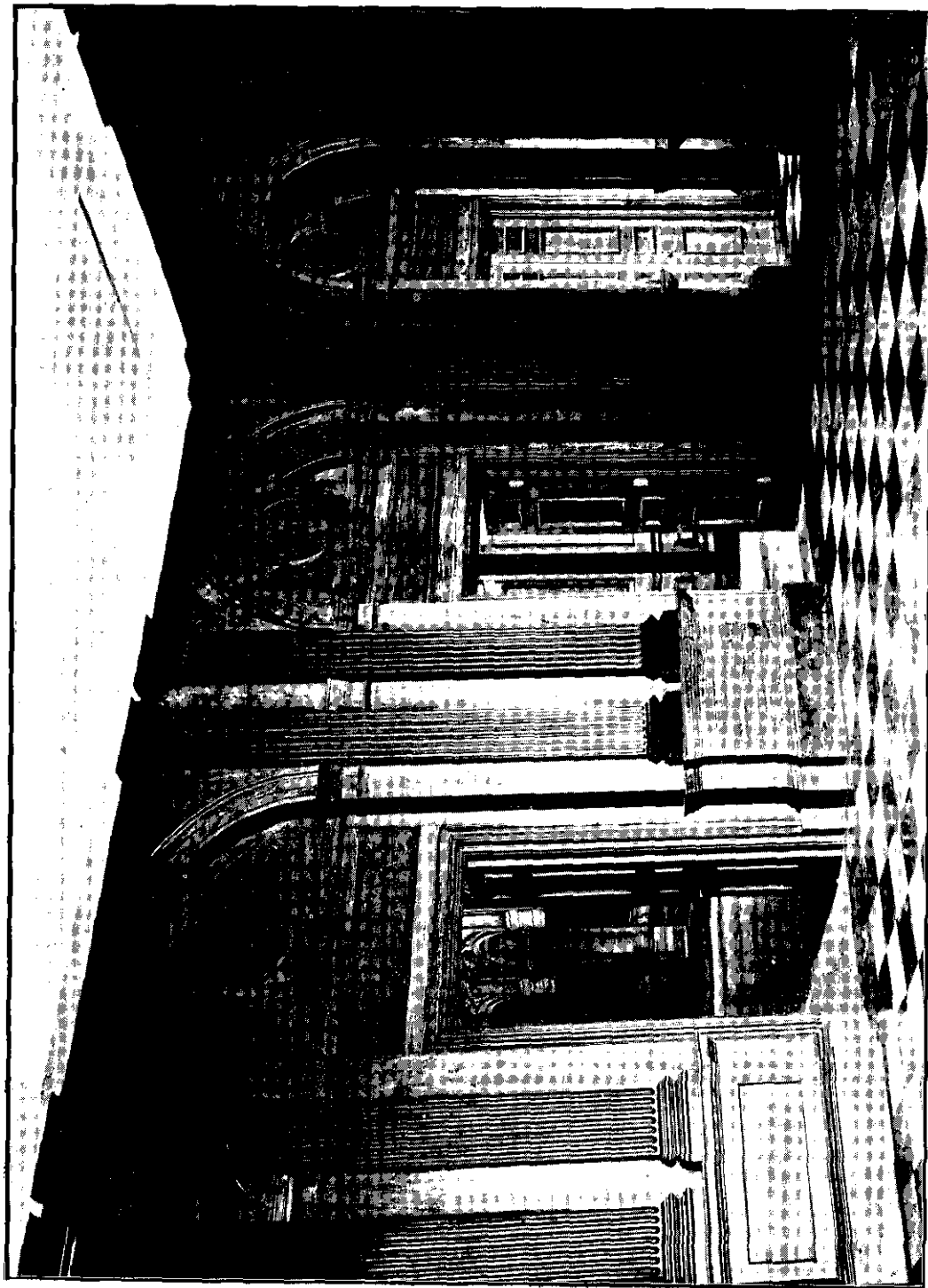
During the first three years of the life of the Research Institute, the situation as regards the Silvicultural Branch remained rather uncertain, and it was only on the appointment of Mr. R. S. Troup in 1909 that it really became an independent charge. Troup held the post for five years, and after him came successively Marsden, Howard and the present incumbent, each holding it for a similar period of four or five years. With steady development both at the Institute and in the provinces it is natural that each of these officers found himself confronted with a distinctive situation, and it is accordingly as easy to distinguish the stages through which the Branch has passed by the nature of the work taken up, as by the successive tenures of the post of Silviculturist.

Early years 1906—1909.—When the Forest Research Institute was opened in 1906, two branches were provided for Silviculture and Working Plans. Mr. Hobart Hampden was appointed Imperial Silviculturist as well as Principal of the Forest College in April. Mr. Caccia became Superintendent of Working Plans in July of the same year and also took over the Silviculture branch in February 1908. In May 1909, Mr. R. S. Troup, was transferred from his post at the Institute as Imperial Forest Economist to the charge of Silviculture and Working Plans, the two subjects remaining in the hands of one officer till working plans were transferred to the Assistant Inspector General of Forests in 1915.

Prior to 1909, but little definite investigation work could be done, although in the course of tours in various parts of India much information was collected and compiled. The urgent need for organised silvicultural and statistical research was, however, becoming increasingly apparent.

R. S. Troup, 1909—1914.—Mr. Troup held the post from 1909 to 1914, and laid the foundations on which we are still building. His chief work was undoubtedly the collection of all available silvicultural information by species under suitable sub-heads, and the final result is seen in his 'Silviculture of Indian Trees' actually published in 1921 after he had left the Forest Research

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The Entrance Hall, showing the doors leading to the Convocation Hall.

Institute. His methods in this direction have been continued almost unaltered ever since. Troup also commenced laying out sample plots for the compilation of yield tables, the first being in the sal forests of the United Provinces in 1909; during his tenure of the post he laid out 164 permanent sample plots of which all but 25 are still maintained. Troup further made a start on systematic experimental silviculture by laying out experimental plots on his tours, chiefly in the United Provinces and the Punjab, and by investigating methods of artificial regeneration in the Kaunli experimental garden near Dehra Dun, which was acquired for this purpose. In connection with these studies, the early stages of development of many species were closely examined and described; the coloured drawings made are as fine as anything of the kind in the world: this line of activity is also still being kept going.

E. Marsden, 1915—1919.—The next Silviculturist was Mr. Marsden, from 1915 to 1919. It was obvious that all that could be done for the time being on the compilation of available information on the silviculture of Indian trees had been done. The experimental plots which had already been laid out or could be laid out, would only give results after several years; the direction for most useful work obviously lay in the collection and compilation of all available statistical data for rates of growth, and this is what next received attention. The data published evoked a certain amount of criticism, which really only served to demonstrate how inadequate were the current methods of collection of growth statistics. The essential measure towards correcting this *viz.*, the laying out of permanent sample plots on accepted standard lines, had already been initiated by Troup, but was taken much further by Marsden who added 113 plots, giving a total of 227 when he made over charge to Howard in 1919.

Relatively few experimental plots could be added with statistical work so much to the fore, and provinces began to realise that to ensure adequate attention to their own particular problems, they must have their own research officers. The United Provinces accordingly appointed a silviculturist in 1918, Burma having already taken the same step in 1916.

Towards the end of Marsden's term, in October 1918, the first Silvicultural Conference was called, primarily to examine in detail the methods of collecting growth statistics, and to standardise the field and computation work. The outcome was Howard's '*Code for the Collection and Tabulation of Statistical Data*'. A standard classification of thinnings, practically that accepted by the International Conference of Forest Research Stations, was also adopted, this being a more important step than might at first appear. The best form for working plan control was also considered and useful conclusions reached.

S. H. Howard, 1919—1925.—Mr. Howard, having been mainly responsible for the methods of statistical research thus standardised, naturally concentrated on putting the whole of this work on a satisfactory basis, and successfully did so. The sample plots laid out by the Forest Research Institute were handed over for maintenance to the provinces wherever a research officer had been appointed—as was being done at this period by one province after another. All new plots laid out by the Provincial Research Officers were dealt with on the standardised lines, all field work being done by them whilst all compilation work was centralised in the Forest Research Institute, a procedure which all are agreed is both satisfactory and economical—in fact, provinces cannot do this work for themselves. The expansion of sample plot work is shewn by comparing the numbers of sample plots in existence in 1919 and 1928. In the former year, there were 297 permanent and 128 temporary plots and in the decade, these numbers became 1131 and 306 respectively.

The data available from the sample plots were worked up by Howard, who published yield tables for sal coppice, chir pine, deodar, and *Dalbergia Sissoo*, and also, in co-operation with the Conservator of Forests, Working Plans, United Provinces, one for sal high forest. This important piece of work is of particular value for the compilation of working plans and estimates of future yields. From the same data also, largely supplemented by further field measurements, single tree volume tables were produced for all these species except *Dalbergia Sissoo*. These

tables are constantly required by territorial officers in estimating the outturn of coupes, etc., and their use is steadily extending.

Meanwhile, it was becoming more than ever obvious that investigation of the main silvicultural problems—regeneration natural and artificial, and silvicultural system—could not possibly be efficiently conducted by the Central Institute.

A second Silvicultural Conference met in January 1922 at which the chief subjects of discussion were the relations between the central and local silviculturists and the record, control and report of silvicultural work in divisions. A paper on a system of filing information in silvicultural research offices was read by Mr. Howard; this was the outcome of the increasing importance of this aspect of the work at the Forest Research Institute, and the realisation that similar problems would inevitably confront the provinces with the passage of time.

One of the resolutions accepted the position that experimental silviculture at the Central Institute must be confined to investigations with seeds and seedlings, and another, that copies of all important entries in the experimental plot files should be sent in by local silviculturists once a year.

Experimental plots were all handed over to the local research officers with the statistical plots, and these officers have of late correctly concentrated on experimental work, sample plots being now easy to deal with as familiar routine, mainly of maintenance. The Central Institute has been kept informed concerning new experimental plots laid out, but uncertainty prevails as to what more is required.

H. G. Champion, 1926.—At the end of 1925, the position might have been summarised to the effect that on the statistical side, methods were effectively standardised and familiar to all concerned, and yield and volume tables had been prepared for all the chief species except for blue pine and to some extent for teak. On the experimental side, useful work on artificial regeneration had been done or was in progress on a small scale, but the work in the forest had been handed over to provinces, the function filled by the Central Institute being simply one of

keeping duplicate records. In the record room, a sound method for collecting information had been devised and was in process of being introduced.

During the four years which have elapsed since then, statistical work has continued on the accepted lines. Field data have been collected in Bengal, United Provinces, Punjab and North-West Frontier Provinces, and so far have been worked up to the extent of compilation of a yield table for blue pine and volume tables for *Acacia Catechu*, *Heritiera minor* (Sunderbans), *Shorea robusta* (Bengal) and *Pinus excelsa*. Experimental work at Dehra Dun has been unavoidably restricted to the narrow lines imposed by situation and climate, but it has been attempted to deal with general problems rather than to duplicate the programme of the United Provinces' Silviculturist. Special attention has similarly been given to developing the general or subject side of the records as contrasted with the species side which was already well organised and had been dealt with by Troup.

The third Silvicultural Conference was held in March 1929, and was attended by representatives from all provinces, including all the provincial research officers: Kashmir also sent a delegate. The deliberations occupied the greater part of a week and thirty subjects were dealt with; the proceedings have recently been published and form an important contribution to Indian forest literature.

The decisions reached are expected to have a most beneficial effect in promoting co-operation and co-ordination in silvicultural investigation work, and are to be embodied in a Research Manual published from the Institute.

Future Work.—It appears safe to forecast that statistical work will long continue as at present, the contribution of the Institute being the calculation and compilation of provincial data, their amplification by the work of special field parties, and the investigation of improved methods in the field and computing office. On the experimental side the function of the Central Institute is now to concentrate on methods of research, leaving to the provincial research officers (as at present) their application

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Section of the Timber Museum, showing furniture and panelling in different woods.

to the solution of specific problems. At the same time it may be found desirable that the Central Institute should take up intensive study of local problems calling for more staff, time or appliances than are at the disposal of provinces, particularly where the co-operation of several experts is required—such as the soil chemist and the physiologist.

In the office, the object is to improve the records to make them of maximum service for all silviculture workers in India. A compendium of Indian silviculture by subjects is in view as a useful objective for the future.

FOREST ECONOMY.

Forest Economy or Utilisation has developed more than any other Branch, and it is really due to the Economic Branch that the Institute has grown so rapidly to its present efficient state.

In 1906 a definite scheme was prepared and sanctioned to establish a Forest Research Institute at Dehra Dun. The first Forest Economist was Mr. R. S. Troup now Professor of Forestry at Oxford University.

The establishment consisted of one Imperial Officer and two clerks, surrounded by a considerable number of miscellaneous files and collections, all of which had to be sorted and classified.

In 1909 a very extensive enquiry on wood preservation was inaugurated chiefly in connection with sleeper woods and this brought up the question of a laboratory or workshop. At that time there was no confidence established that money spent would yield any return, but the difficulty was partially overcome by the Economic Branch appropriating an old shed or godown belonging to the College. As the sphere of activities widened, new investigations were started, the most important of which dealt with a very extensive enquiry into the utilisation of bamboos for the manufacture of paper-pulp, the development of the sleeper enquiry, the question of more up-to-date methods of distilling essential oils, the development of the utilisation of *Boswellia*

serrata gum-oleo-resin, and many others. It is sufficient to say that the work increased and what was of greater importance, a definite connection was established with local forest officers, the commercial world, and the railway engineers.

The next definite step was in 1914, when it became more apparent that expansion was necessary. It was decided to erect a large central building surrounded by what was then thought to be suitable laboratories and workshops. This was done at Chandbagh.

At the time this new Institute building was erected, it was anticipated that accommodation was sufficient, without further expansion, for 20 years at least. War, however, taught many lessons, and amongst them it proved that the staff, equipment, and accommodation was entirely inadequate to meet the numerous enquiries and investigations which had to be undertaken. The war, moreover, gave a much needed impetus to the utilisation of the various timbers found in the forests of India and Burma, other than those in common use, and this fact, more than any other, drove home the importance of further expansion in timber utilisation.

In 1918 schemes were considered to develop the present Institute and the ideas were generally accepted and approved in 1919. It was finally decided to start a new Institute some two miles from Dehra Dun and utilise the present buildings for educational purposes.

By the end of 1920 some of the experimental plant and staff had arrived in India but the new laboratories and workshops were not ready, and so it was decided to erect a small portion of the plant in the old laboratories at Chandbagh, so as to get the specialists at work, and train a nucleus of wood workers and machine and kiln operators. Towards the end of 1921, the new laboratories and workshops were put in hand and construction made rapid progress. Erection of machines began in 1922, but it was not till 1923 that the wood workshop and sawmill were running and the timber testing laboratories in working order. The other Sections, owing to lack of water, have only been running since 1924.

The Branch is now divided into Sections covering wood technology, timber testing, wood preservation, kiln seasoning, paper-pulp, minor forest products, and wood working. The workshops are separate from the main building and were constructed before it.

This Branch is in intimate relation with the most important users of timber, and forest products, for example, the Railways and the Gun Carriage Factory, and is continually giving advice to these and other commercial and semi-commercial concerns. To ensure continuity of experimental work a biennial programme is passed by the Inspector General of Forests and the different enquiries are carried on under the provisions of printed projects in which the lines of research are laid down.

In the Timber Testing Section statistics have been compiled for over 60 species and during the past year 33,500 mechanical tests were made. As examples of the results of tests made in the laboratories, the life of aeroplane wing spars in India was extended from five to seven years, and local wood is being used on a large scale in the oil wells of Burma in place of the expensive hickory.

In a climate like India nothing can be more important for users of timber than to see that their wood is properly treated before it is made up. The best methods of seasoning many important timbers have been ascertained. As a result the Gun Carriage and Rifle Factories and the Railway Board have installed batteries of kilns. At the Gun Carriage Factory at Jubbulpore nearly 40,000 c. ft. of timber is being kiln-seasoned annually, resulting in the release of enormous capital, which was previously locked up in the form of seasoning timber stored for many years. Most successful seasoning operations have been carried out on 1000 walnut rifle parts seasoning them in seven weeks instead of five years.

The most important work done in the Wood Preservation Section is in connection with railway sleepers. Four treating plants have already been erected by Indian Railways. The North-Western Railway are now treating as many as 800,000

spruce and fir sleepers annually, whereas five years ago neither of these timbers was considered to be of any use. The work of this Section will result in the profitable utilisation of millions of tons of second class woods which would not otherwise find a market for years to come.

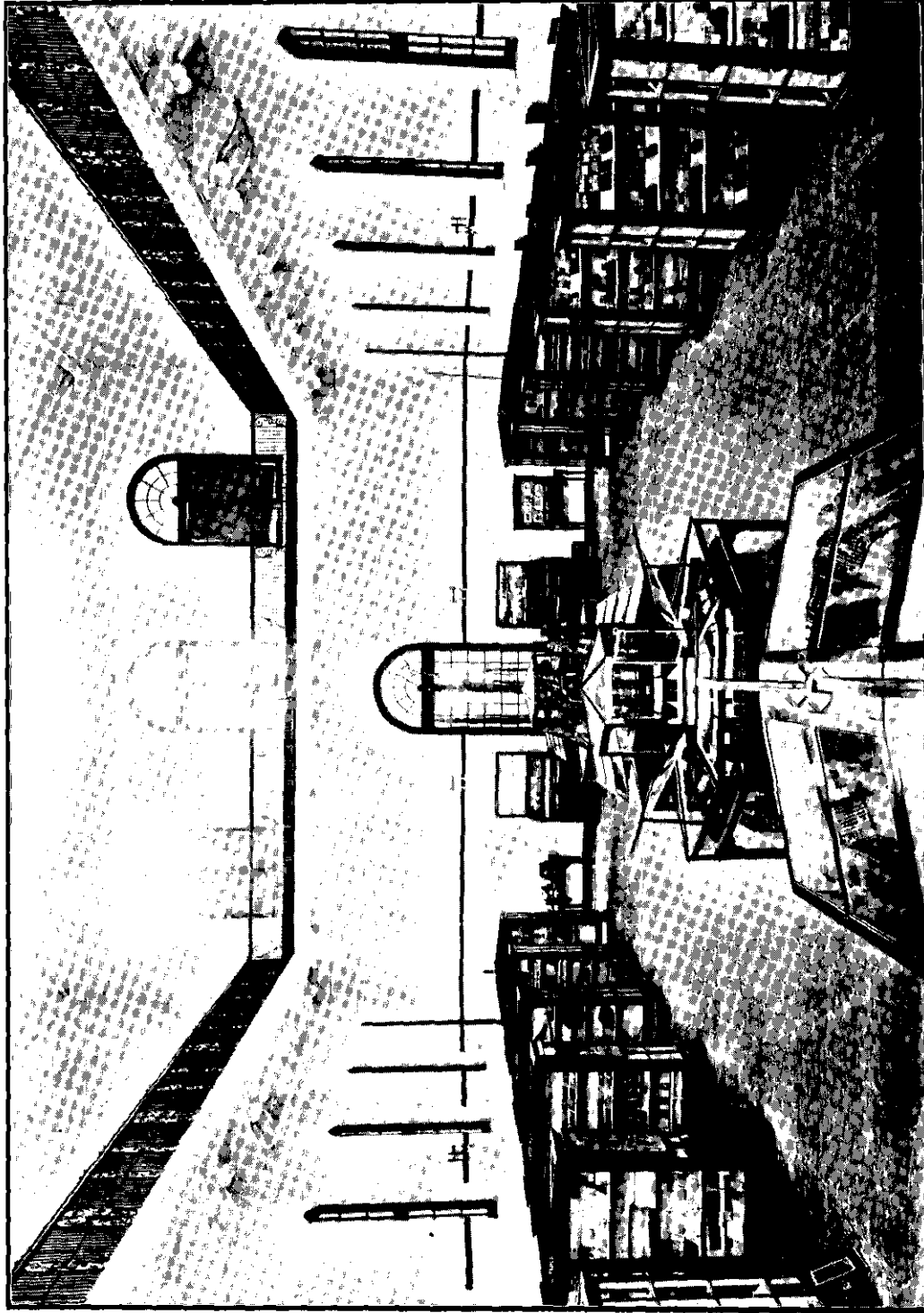
Bamboos cover very large areas in India and Burma, and the Paper Pulp Section has proved that they can be profitably utilised in the form of paper-pulp. Difficulties in digestion have been overcome through the skilled investigations of Mr. Raïtt who has examined and reported on the pulp propositions in the forest. As a result syndicates have already taken up concessions. It is believed that it may be found possible to use bamboos for making artificial silk, and samples have been sent for trial.

The basis of all proper utilisation of timber is a knowledge of its structure, and this is especially the case in India where there are so many different hardwoods. The Wood Technology Section gives valuable information to the other Sections and is continually receiving requests to identify specimens of wood.

The Wood Working Section is a most important part of the Economic Branch. It receives large quantities of timber from all over India and Burma and converts them into sizes required for experimental work. In the Section itself all the most important woods are used for carpentry, veneering, plywood etc. Indian carpenters are trained in large numbers in modern methods. A modern sawmill deals with the logs and a fully equipped machine shop handles the output from the mill.

In considering the total export trade of India in forest products it may be noted that the value of minor products exported considerably exceeds that of timber. The value of lac exported annually runs into millions of pounds. The Section of the Forest Research Institute which deals with these products is now properly manned and equipped. The large majority of forest species yield something of use to man, and in Burma alone, where there are some 3000 woody plants, there is an immense field for investigation. Skilled modern treatment

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Minor Forest Products Museum.

of the resin of one of the Indian pines in the Punjab and the United Provinces has already resulted in India becoming largely self-supporting in the matter of turpentine. Among other forest products which offer profitable fields for scientific inquiry are gums, oils, cutch, fibres, tanning and dyeing materials, charcoal, drugs, spices, and fodder plants.

All the Sections of the Economic Branch are now manned and equipped with up-to-date machinery and apparatus.

Elsewhere in this number will be found a reference to the Committee appointed in February 1929 by the Government of India; it went thoroughly into the working of the Institute and made many valuable recommendations especially in connection with the Economic Branch. Their recommendations are now under the consideration of the Government of India.

ENTOMOLOGY.

Research work may be considered under the heads of Systematics, and Biological Investigations and Educational.

Systematics.—From 1906 to 1920 the Forest Entomologist was responsible not only for biological investigations but for the correlated systematic work, *i.e.*, identifications, taxonomy and maintenance of a reference collection. In 1919 when the expansion of the Branch was sanctioned a Systematic Entomologist was appointed whose duty is to build up a collection of the forest insects of India with the co-operation of a large body of specialists in Europe and America; this now contains 12,377 identified species and perhaps another 5,000 for which names have not yet been secured. The number of specimens runs to hundreds of thousands with an annual addition of 30,000 to 90,000. The rate of growth of the collection is as below:—

Period.	Average annual increase.
1915—1919	69 species.
1920—1924	540 species.
1925—1929	1126 species.

The known insect fauna of India amounts to some 45,000 species and that of the world to 640,000 species to which, it is authoritatively stated, several millions of species have yet to be added. Systematic entomology is thus international and can only progress by the distribution of the work to specialists in all parts of the world. The special share of Dehra Dun in this work comprises certain groups of beetles (Cerambycidae, Lamiidae, Scolytidae, Platypodidae) and the larval or early stages of forest insects. On an average ten systematic papers are published annually in foreign periodicals.

Biological Investigations.—The lines on which biological research in forest entomology has been carried out have been determined by the following policy :—

The most satisfactory means of discovering the conditions that reduce or eliminate the insect pest hazard during the growth of a forest crop are by applying the whole time of one investigator to one problem and by maintaining continuous field-observations. It is unprofitable for one man to attempt to run several investigations concurrently in different climatic regions and in different types of forest. This principle is generally accepted in applied entomology and was accepted for Indian forestry in 1919 when the creation of four posts, under the designation of Regional Entomologists, was sanctioned with the intention of assigning one man to the insect pests of teak, one to those of sal one to those of Himalayan and submontane forests and one to those of evergreen forests.

These extra posts were not filled, but the assumption that work on insect pests would eventually be organised on these lines placed the function of the Forest Entomologist on an all-India basis rather than constituting him a Regional Entomologist with special reference to the pests of forest types of N. W. India. During the last ten years, therefore, the chief object has been a general survey of the life-cycles, food-plants, geographical distribution, natural enemies and particular ecological features of the forest insect fauna of India and Burma, with, as a secondary object, the more intensive investigation of certain major pests which could be studied either at Dehra Dun, or by means of

field-insectaries in charge of assistant entomologists. In actual practice the principle of Regional Entomologists has been delegated intermittently and on a minor scale to subordinate officers.

General ecological research is an essential supplement (frequently a preliminary) to the intensive local study of pests, and it can only be carried out by means of a central institution in India in which country the contributions from other sources (*e.g.* universities, allied departments, private individuals) are entirely negligible. This policy was further facilitated by the absence of urgent demands from the provincial forest departments for the control of pests except at times of epidemics.

The attitude of the provinces towards insect pests has generally been that preventive measures are not practical in natural high forest, and that remedial measures can be postponed until the very existence of the forest is threatened, or its re-establishment is prevented. The only pests of commercial interest are thus the fatal tree-killing species and those of distinctly spectacular effect in plantations of special importance; pests causing depreciation of timber or other forest products after exploitation appear to interest the forest officer only indirectly.

In research for control measures the procedure is to carry the investigation to a point at which it becomes evident either that the pest is controllable by modification of the prevalent cultural practice (*i.e.*, by a method of prevention); or is controllable by a non-cultural remedy (*i.e.*, by a method of direct destruction); or that there is little hope of a solution without prolonged intensive research. On reaching this stage further progress is checked by ignorance of the financial aspect of preventable damage by pests.

In order to illustrate the problems arising in forest entomology and the methods of investigating them we may take two large all-India surveys that have been in progress for many years, *viz.*:—the borers of Indian timbers and the defoliators of teak.

The borers of freshly felled trees, of timber under storage and of seasoned and manufactured timber, comprise an enormous complex of insects; they are particularly numerous in the wet sub-tropical and evergreen forests. A survey of the distribution, food-plants, seasonal abundance, natural enemies, etc., of the various species has been carried on continuously by caging infested logs from all parts of India in the Insectary at Dehra Dun. From the data recorded it is possible to say what timbers can be protected by felling at safe periods, or by barking, or by special methods of air-seasoning or only by treatment with antiseptics.

The defoliation of teak has been studied from the ecological and statistical aspects by using temporary field-insectaries. Two of the most important species have 10 to 13 broods a year, so that the danger of wholesale defoliation exists all the year round. As prompt remedial action against defoliation of such rapidity can rarely be organised, teak plantations must rely largely on natural controlling agencies for protection. The parasites and other checking factors are being investigated with this object. On the statistical side, maps of the intensity of defoliation have been made month by month since 1926 over the whole of the Nilambur teak plantations.

In coniferous forests the chief pests are bark-beetles and other bark and wood-borers, and these have been studied from Kashmir to Kumaon. Control is a matter of general management rather than of special anti-pest remedies. While a uniform system of management with concentrated clear-felling increases the hazard, the proper disposal of slash effectively neutralises it. Defoliation of conifers is generally unimportant but the deodar periodically suffers from epidemics of a looper caterpillar; the biology of this pest is now known and future outbreaks can be brought under control.

Among pests that are capable of seriously hindering or entirely preventing the establishment of artificially regenerated, or pure crops may be cited the toon shoot-borer, the babul borer, the teak canker-grub, and the shisham defoliator. These have come into existence as pests as a result of extensive plantation

schemes and they can only be controlled by radical modification of the silvicultural practice in force.

Among the pests of mature forest the two most notorious are the beehole borer of teak and the heartwood borer of sal.

The beehole borer makes its tunnels in the living tree year after year without killing it, and the accumulated damage of a century or more is revealed at the final felling. It is conjectured that this insect causes an annual loss of ten lakhs, to the Government of Burma on teak extracted departmentally while the losses to firms are two or three times this amount. Preliminary research has discovered no remedy for this peculiar and baffling pest, and the investigation is now being continued by the Forest Zoologist, Burma.

Fifteen years ago the sal heartwood-borer was not considered a particularly destructive pest; now-a-days it ranks as the most injurious forest insect in India. This is partly due to a series of bad epidemics in the United Provinces and in Central India, and partly also to a better realisation of the financial position of such catastrophes. The average annual loss due to the sal borer in Government forests is not less than two and a half lakhs, or about 2 annas per acre per annum; in epidemics the loss rises to enormous proportions as the following cases demonstrate.

In a small epidemic affecting 8 square miles of forest in the United Provinces 45,000 trees amounting to nearly a million cubic feet of timber were killed representing a loss of Rs. 2,70,000 or Rs. 17 as. 10 per acre; in the following four years control measures were enforced and the annual loss was reduced to 14 annas per acre, *i.e.*, the average annual loss during the control period was 88 per cent. less than the average annual loss during the uncontrolled period. The loss prevented was between Rs. 1,30,000 and Rs. 3,00,000 or about Rs. 10 per acre per annum.

A diffuse epidemic involving a division in the United Provinces was controlled in 2 years by the same methods.

More recently an epidemic affecting five forest divisions of the Central Provinces, an Indian State and much private land has occurred, which is the most serious on record. When remedial

measures were adopted it was found that on 150,000 acres of sal forest in two divisions timber to the extent of Rs. 7,50,000 had been destroyed. In the following year the attack had risen to five and a half million trees on this area representing a loss of forest capital in the neighbourhood of Rs. 13,750,000. The first advisory visit of the Entomologist is stated by the local officers to have increased the efficiency of the control operations very considerably, and the last visit resulted in the discovery of a new accessory measure, which increased efficiency by 100 %. The latest reports indicate that the control operations have reduced the 1928 attack to one-tenth of the previous year's attack over the greater part of the area and to less than one half in the worst infested localities, *i.e.*, a loss of several millions of rupees has been prevented.

The 1929 attack was much less severe and it is now considered that special control operations can be abandoned.

At the present time the chief difficulties of research in forest entomology are in connection with the collection of the statistical information needed to correlate the cost of control operations with the loss prevented. Both are definitely local factors and should be worked out by the local executive, but the propaganda necessary to stimulate activity in this direction is not yet available. In 1925 at its last meeting the Board of Forestry considered the possibility of collecting statistics on the losses due to insect pests and expressed the opinion "that the Entomological Branch cannot undertake much more detailed local work and that when any province is anxious to have an enquiry made on any special pest that province should collect the data required by the Entomologist and arrange for the training and employment of the necessary staff under the guidance of the Entomologist".

In practice this has not amounted to much, and the situation will not be improved until pest control is familiarised as a commercial proposition and a cultural asset. The best solution appears to lie in the appointment of experienced Deputy Conservators to the vacant posts of Regional Entomologist for periods of 3 to 5 years to continue the study of pests particularly affect-

ing their Provinces and to operate and evaluate control measures. This amounts to a non-recurring outlay of Rs. 1,00,000 to Rs. 1,50,000 to solve problems involving annual losses amounting to lakhs.

Educational Work.—Lectures in Forest Zoology were formerly given as a one year course to the Provincial Forest Service Class and now as a two year course to the Imperial Forest Service Class by the Forest Entomologist and an Upper Grade Assistant.

BOTANY.

The Botany Branch was constituted in 1906 when Mr. H. H. Haines was appointed Forest Botanist. He was succeeded on 27th May, 1907, by Mr. R. S. Hole who remained till 13th December, 1922.

Mr. Haines appears to have spent his time mainly on systematic botany starting an extensive collection of the genus *Grewia* and sending a collector to Bihar and Orissa. For this province he published a flora after retirement.

Mr. Hole continued the study of the genus *Grewia* and started publishing the results in the *Indian Forester* of 1917. The series of articles on the genus was, however, never continued.

Mr. Hole did a considerable amount of work on forest grasses partly from the ecological side as indicators for soils and forest types, and partly from the economic side investigating the effects of annual firing or cutting on the composition of grasslands and the stocking as sources of fodder or pulp-materials. His work also dealt with systematic botany in the case of some species and varieties of grasses.

Mr. Hole carried out an elaborate series of experiments with sal seedlings studying especially the phenomenon known as "dying-back". This dying-back was looked upon as being a natural phenomenon and to some extent it is in that it occurs extensively in nature. Hole's work, however, showed that dying-back is not inevitable for several years until sal seedlings become

established. It was further found that most of the mortality of sal seedlings occurred during the rains and is due to temporary water-logging causing an excess of CO_2 and deficiency of oxygen in the soil.

This work on sal seedlings led to the importance of soil aeration being appreciated in a way it had not been previously. The well-known injurious effect of grass on trees and the improvement in conditions sometimes brought about by fire can in some cases be traced to the CO_2 content of the air in the soil.

An investigation of *Trametes pini* led to the conclusion that this fungus can only be controlled by stopping the extensive lopping of blue pine in the forests where it is rampant.

In 1908 the herbarium of the Botanical Department of Northern India was transferred to Dehra Dun Herbarium. and amalgamated with the much smaller Forest College herbarium. The approximate number of sheets in these two herbaria is not now known and cannot be ascertained as numerous duplicates have been sorted out and distributed in exchanges. Also from time to time useless specimens are removed and destroyed.

The herbarium has been added to at a steadily increasing rate. 21,472 specimens were added from 1906 to 1920-21. From 1920-21 to 1927-28 the additions amount to 28,027 sheets. It is now estimated to contain 222,000 sheets.

Identification of specimens for persons not connected with the Research Institute has also increased greatly. The average number of specimens identified during the 5 years ending 1913 was 100 per annum. During the last 5 years it has averaged 326 per annum.

The herbarium has been used as the principal source of material for the Forest Flora of the Punjab issued in 1918 and a second edition in 1924. Also for the Forest Flora of Kumaon issued in 1927. For the Flora of the Chakrata, Dehra Dun and Saharanpur Divisions and for the completion of the Flora of the Upper Gangetic Plain.

A great deal of identification work done in Dehra Dun for the following works which were partly or wholly prepared in Dehra Dun :—Parkinson, Flora of the Andamans; Witt, Descriptive List of Trees &c., for Berar; U. Kanjilal, Preliminary list of plants of Upper Assam; P. C. Kanjilal, Forest Flora for the Eastern Circle, United Provinces.

Efforts have recently been made to bring the valuable material accumulated to the notice of workers abroad. Two special articles on the genus *Plantago* and family *Cruciferae* have appeared in the *Notisblatt des Bot. Gard. u. Mus. Berlin, Dahlem* dealing entirely with specimens sent on loan from Dehra Dun.

Material has been sent on loan to workers in Australia, Russia, Germany and Sweden and has been asked for by workers in Java and the United States.

The whole of the *Umbelliferae*, part of the *Boraginaceae* and the genera *Juniperus* and *Tamarix* are at present on loan with specialists in Europe.

The meeting of seed indents is a branch of work which has grown considerably. In 1924 a list of seeds that can be readily supplied was printed and circulated to Botanical Gardens abroad and to some of the principal horticultural gardens in India. The seeds were offered in exchange and large numbers of economic plants were asked for and supplied to botanic gardens in Europe and elsewhere particularly Egypt, Australia and the Panama Canal Zone. The third revision of this list is now due.

Apart from such exchanges 58 specific indents were received in 1927-28 comprising 475 items. These indents were partly from the Silviculturist, Forest Economist or other forest officers in India but also from the Forest Departments of Goa, Ceylon, Java, Sumatra, the Philippines, China, Japan, West Australia, New Zealand, Mauritius, South Africa, Nyassaland, Tanganyika, Kenya, Uganda, the Gold Coast, Nigeria, United States and Porto Rico and from the Governments, Agricultural Departments or British Consuls in Abyssinia, Somaliland, Sudan, Seychelles, Madagascar, Iraq and Egypt.

In the case of timbers and economic products, especially, drugs, it is frequently difficult to be certain of the plant which yields any particular product. The older timber collections are very unreliable as there is often no means of checking the identity of any specimen except by comparison with other timber specimens equally unreliable. Consequently a timber collection is being gradually built up of specimens which have been botanically identified from herbarium specimens collected from the tree felled for the timber blocks. These herbarium specimens are preserved and labelled to show that they belong to timber specimens kept by the Forest Economist and can be referred to subsequently in cases of doubt.

Many drugs are in a very unsatisfactory position in that they are yielded by more than one plant and it is often not known if all are equally valuable apart from deliberate adulteration with superficially similar articles. In 1921 in response to a request from Professor Greenish of the Pharmaceutical Society's Research Laboratories, London, pure samples of seed of "kaladana" *Ipomœa hederacea* and of five other species of *Ipomœa* were supplied and examined with the object of finding a means of telling the genuine seeds from substitutes. Since then samples of various species of *Berberis* have been supplied to see if all the common species are equally useful for "rasaunt" and to discover if possible a means of distinguishing the species in the form of sticks of wood.

Numerous samples of myrabolans (fruits of *Terminalia Chebula* and other species) were supplied to the Imperial Institute, London. The object of the investigation being to ascertain which of the varieties of *Terminalia Chebula* mentioned in the Flora of British India yielded the best fruits for tannin content.

Large numbers of specimens of the various oil-yielding grasses, *Artemisias* and *Ephedras* have been examined and identified for the investigations of the Forest Chemist and material has been provided for many of his investigations.

There is a great deal of work to be done on similar lines with most of the Indian drugs and minor products.

The special questions now under investigation are a root disease of shisham very wide spread and destructive in the Punjab and United Provinces and a stem disease of *Pinus longifolia* caused by Peridermium. The shisham fungus has been under study for several years the progress being slow partly owing to natural outbreaks of the disease causing the results of artificial inoculations to be practically worthless. Secondly it was soon found that two different species of fungus cause the same symptoms the one common on shisham in the plains being rare on this species in Dehra Dun but common on *Albizzia*. Inoculations with both these species on healthy shisham roots have so far failed to reproduce the disease. It appears that another fungus and possibly two others are the primary cause of the disease. One of these is a *Fusarium* and it has been found capable of killing healthy roots of shisham when they are inoculated with it. The progress of the inoculation and death of the roots by *Fusarium* alone is very slow and in 4 years small trees have not been killed by it. It seems probable that a subsequent inoculation of roots damaged by *Fusarium* with one of the fungi first suspected but found incapable of infecting healthy roots, will reproduce the disease as found in nature. It will probably be some years yet before this investigation is finished and the effects of primary and secondary infections known.

Work on the Peridermium is directed to discovering the alternate host of the fungus. This is at present unknown and a suspected alternate stage can only be proved to be the one sought for as the result of successful cross inoculations. So far a good deal of negative evidence *i.e.*, failure of cross inoculations has been accumulated but this alone is not conclusive as inoculations even with the proper fungus do not always take. Meanwhile the Peridermium on chir has been found to be more widely spread than was supposed and it appears to be on the increase. The only means of prevention is to discover the alternate host and if practicable eradicate it from the neighbourhood of pine forests.

At the instance of workers in the United States who suggested that the original home of the White Pine Blister Rust was the

Himalaya search was made for the fungus on *Ribes rubrum*. It was soon found in Hazara and specimens were identified in England and America as *Cronartium ribicolum*. The Peridermium on *Pinus excelsa* however is rare in the Himalaya but specimens have been found in various places. These have been stated however not to be *Peridermium Strobi* but a new species of Peridermium. The present position is very unsatisfactory in that one stage of the fungus viz., *Cronartium ribicolum* is admitted for the Himalaya. The alternative stage should be on *Pinus excelsa* and should be *Peridermium Strobi*. A Peridermium has been found on the stem of *Pinus excelsa* but it is stated by experts in the United States not to be *Peridermium Strobi*. Efforts have been made to cross-inoculate *Pinus excelsa* from *Cronartium ribicolum* but hitherto without definite results. American species of 5-needled pines known to be susceptible to *Peridermium Strobi* have been sown in Mussoorie and Hazara for cross-inoculation work but they are too young to be used at present.

An arboretum is being established in the grounds of the Institute in addition to avenues along all the main roads. Owing to uncertainty as to the use to be made of a great part of the area only certain families have so far been taken up. In these families 355 species have been planted represented as a rule by 3 or 4 specimens of each. As nothing can be planted without protection from cattle an area of 22 acres originally intended for an arboretum has been fenced and planted mainly with the smaller trees, shrubs and climbers unsuitable for grazing grounds. These have been arranged in their families and will in time be useful for students in showing the characters of the various families as well as showing specimens of all the more important and useful plants belonging to the various families in so far as they can be grown in Dehra Dun. The number of species so far planted is 525 but they probably cannot all be grown in Dehra Dun and many will doubtless disappear in a few years. This work was started in July 1927 and so far there have been very few casualties, these were due mostly to white-ants rather than unsuitability of the species planted.

CHEMISTRY.

With the creation of the Forest Research Institute in 1906, the branch of Chemistry was established, and Mr. Puran Singh was appointed Chemist on April the 5th, 1907. No laboratory was provided at first or his work well defined, the analyses of forest soils being said to be his chief duty. A room was allotted to him in the Forest School, where he worked till 1909, and he then moved to a hired bungalow on the Rajpur Road.

The lack of accommodation and research facilities in 1907 and the following years limited the scope of the work of this branch to chemical evaluation of materials submitted by other officers of the department. The work was carried on with the help of an assistant Mr. T. P. Ghose, B.Sc. (appointed in 1910): and whenever an opportunity offered attempts were made in the direction of original investigation. The results of the first original work on the 'Analysis of Cutch and the preparation of pure Catechin' were published in the Indian Forest Memoirs Vol. I, Part I, October 1907. During these years (1907—1914), enquiries on chemical matters from all over the country were attended to. Of these, a few are of outstanding interest and are, therefore, mentioned in some detail.

It is common knowledge that the sap extracted from the bark of the tree *Melanorrhœa usitata* constitutes the raw Burmese varnish. The remarkable similarity in appearance of the Japanese and Burmese varnishes, coupled with the fact that the methods of their employment in lacquer work in Japan and Burma are similar in many respects, led the Forest Chemist to suppose that the two lacquers were identical in chemical composition. The chemical investigation established the identity of the two varnishes, and many useful recommendations were made with a view to improving the lacquer industry of Burma.

A considerable amount of time was spent on an investigation into the causes of the objectionable colour of the extract from mangrove (*Rhizophora mucronata*) bark as prepared at the Government Tanning Factory, Rangoon. After a series of experiments to produce light coloured extracts, it was suggested that a judicious mixture of tanning materials of different colours should

be employed, instead of using any one single tanning material. By this procedure the tanning properties of the original materials suffered no deterioration in the mixed extracts, and the colour of the extract from the highly coloured materials could be reduced to the desired degree by altering the proportions of the ingredients. These suggestions were adopted by the factory at Rangoon.

Another interesting investigation, made at this time, was on palmarosa grass (*Cymbopogon Martini*, Stapf) oil. There are two forms of this botanical species which are popularly known as *motia* and *sofia*. Although they have not been recognised as botanically distinct, chemically they are quite different, *motia* variety yielding palmarosa oil, while *sofia* gives the well known 'ginger grass' oil. The importance of palmarosa oil as an article of trade is due to geraniol, which is present to the extent of 84—90%. The *sofia* oil, on the other hand, contains only 34—40% geraniol and has a peculiar penetrating odour, due to which it does not find a ready market. As a result of the experiments, it was possible to make very helpful suggestions regarding the collection of the grass, its storage and the method of distillation. By adoption of these suggestions, considerable improvement was made in the quality and the quantity of the oil obtained from the grasses. In certain parts, palmarosa grass is now cultivated and the oil obtained, stands the test and competition in the market.

The opening of the Institute Buildings at Chand Bagh in 1914, provided a separate building in the grounds with the much needed equipment. The laboratories had, besides the main analytical rooms, a building for a distillation plant required for operations on a semi-industrial scale. The provision of a laboratory gave the Chemist an opportunity of proving the value of the branch. The demand for analytical work steadily increased and left the small staff little time for original work. Nevertheless, a good deal of investigation was carried through with the object of demonstrating on a commercial scale the possibility or otherwise of developing certain industries.

The help that the branch has rendered towards the establishment of the turpentine industry in India may be of interest. As

early as 1888, a small experimental still for the distillation of oleo-resin from *Pinus longifolia* was set up at the Forest School, Dehra Dun. The results obtained were very encouraging and this in an indirect way led to the establishment of a still at Bhowali, United Provinces in the pine forests of the Himalayas, one at Nurpur in the Kangra District, and one at Kalsi, Dehra Dun, at a later date. The turpentine obtained from these stills was of a fairly good quality but the methods of extraction were regarded as wasteful and uneconomic, so in 1914 the Forest School distillery, and the Nurpur and the Kalsi distilleries were closed down. The Bhowali distillery lingered on through all these years and continued to do useful pioneering work, in connection with the methods of tapping the tree, transport of the resin, and the methods of distillation. With the creation of the Forest Research Institute, interest in this industry was revived and several enquiries were made as to the best method of distillation. In co-operation with the Forest Economist at the Research Institute, the Chemist took up the problem and made various suggestions by which the quality of turpentine was considerably improved. In 1910, the Punjab Forest Department started a plant for the distillation of turpentine with steam, and deputed Mr. Gibson to study the distillation processes in France and the United States of America. As a result a turpentine distillation plant of the latest French pattern was erected at Jallo, near Lahore, in 1916.

In accordance with the decision of the Board of Forestry (April 1910), Mr. Puran Singh undertook the examination of the resins of the principal conifers of India. This led to the examination, in 1911, of the resin from *Pinus excelsa*. It was shown that the yield of oil and colophony was practically the same as that from the resins of *Pinus longifolia*, but the quality of the oil obtained was very much superior and, in fact, was equal to the best grades of French and American turpentine. Professor Dunstan of the Imperial Institute, London, to whom a sample was sent, reported that 90% of the oil distilled between 150°—160°C and was of very superior quality and would find a ready sale in England. No record is available to show if any attempt was made to collect

the resin on commercial lines. The oil obtained from the resin of *Pinus Khasya* of Burma also received a good report. The tapping of such pines on a large scale in Burma was suggested by the Chemist, but, on account of transport difficulties, this has not been tried commercially.

Another oil which might replace turpentine was found in the oleo-resin of *Boswellia serrata*. Preliminary experiments on the chemistry of the oleo-resin showed that it contained an essential oil (8—11 %), of the nature of turpentine, a resin (55 %) of the type of colophony and a gum (25 %). The difficulties of separating the constituents were great and these were eventually overcome by extraction with suitable solvents. The oil obtained was shown to be nearly equal to the American and French turpentine for the manufacture of varnishes etc. The commercial aspect of utilising the other constituents of the oleo-resin was also explored and the attempts are recorded in the Indian Forest Records, Vol. VI, pt. VI, 1918.

Reference may also be made to the preliminary work that was done in this branch in connection with the manufacture of thymol from *ajowan* (*Carum copticum*, Benth) seeds. During the war, a manufacturing plant was erected in Dehra Dun. After a successful run of several years, this had to close down, due to German competition, the local factory being unable to utilise the residual bye-product, for which the Germans found a ready market as fodder.

Mr. Puran Singh appointed in 1907 retained the post with short breaks till 1918. Mr. C. F. Cox, I.F.S., held charge of the branch for a year (1918-1919) and then Dr. J. L. Simonsen, originally a member of the Indian Educational Service and Professor of Chemistry at the University of Madras, was appointed. He had already done valuable work on the constitution of certain terpenes and, therefore, found the work at the Forest Research Institute most congenial and to his liking. He collected some very valuable data on the constituents and constitution of Indian essential oils.

The first subject that attracted his attention was turpentine. It was a usual practice to send for opinion, to the Imperial

Institute, London, turpentine oil distilled in India. The report indicated that even the best Indian oil was inferior to the American or French, because on exposure it readily oxidised and left a sticky residue. It was also pointed out that the oil was a mixture of terpenes, the most objectionable portion being a heavy oil, which distilled towards the end of the operation. On further study of the problem in this department, it was shown that *Pinus longifolia* oil contained α and β -pinene, a new bicyclic terpene d- Δ^3 -carene; and a tricyclic sesquiterpene d-longifolene which constituted the objectionable heavy oil referred to above.

The cause of the rapid oxidation of the Indian turpentine oil was found to be due to the presence in it of d- Δ^3 carene. With a view to preventing this oxidation a series of experiments were started and as a result, it was found that anti-catalysts such as pyrogallol or resorcinol more or less completely inhibited the oxidation.

The oil from *Pinus excelsa* next attracted the attention of Dr. Simonsen, preliminary work on which had already been done by Mr. Puran Singh. It was found that the oil contained 88% of pure α -pinene, and the rest consisted of d-terpineol, a sesquiterpene, and a small quantity of n-undecane, a hydrocarbon of the paraffin series. Oils from *Pinus Khasya* and *Pinus Merkusii* were next studied. The oil from *Pinus Khasya* was found to contain d- α pinene, d- β pinene, and about 10% of d-longifolene; and the constituents of the oil of *Pinus Merkusii* were d- α pinene, d- β pinene, d- Δ^3 carene and d-longifolene. The amount of carene and longifolene being small raised the commercial value of the oil in comparison to longifolia turpentine. To complete the detailed chemical study of the oils from Indian conifers, the *Pinus Gerardiana* oil was also investigated. It was found to consist almost entirely of d- α and β -pinene, and a small amount of a sesquiterpene. Owing to the inaccessibility of the regions where these conifers grow, this source of turpentine has never been commercially exploited.

The constituents of the oils of several grasses, leaves and seeds were studied at this time and a few of these require special

mention. A stray enquiry from a person in Abbottabad resulted in his sending to this Branch the *Andropogon Jwarancusa* grass, the essential oil of which was investigated and shown to contain a valuable constituent, piperitone. The ease with which piperitone could be oxidised by iron chloride into thymol, gave it a special interest and importance. It was again in a similar manner that *Skimmia Laureola* was received for investigation. The oil obtained on steam distillation of the leaves was found to consist mainly of L-linanyl acetate. The linanyl acetate is important from the point of view of perfumery industry, as it forms the base of lavender perfume. Unfortunately, trade did not accept the linanyl acetate from this source, and a very low price was offered for it in London market.

The study of the constituents of the essential oils of *Blumea Malcolmii*, *Abies Pindrow*, *Juniperus communis* and camphor were also studied at this time. Amongst the oils and fats that were investigated the following may be mentioned—*Chloroxylon Swietenia*, *Calophyllum Wightianum*, *Shorea robusta*, *Mimusops Elengi*, *Garcinia Cambogia*, *Aleurites montana* and *Salvia plebeia*.

It is well known that Russian Turkestan used to be the chief source of supply of the valuable drug santonin. Due to the political conditions in that country and the closure of international trade with Russia, supply of this drug was entirely cut off and the price of santonin rose to fabulous figures, especially during the war. Other sources of this drug were searched for, and in January 1921, Professor Greenish directed attention to the presence of santonin in the leaves of *Artemesia brevifolia* Wallich, *Artemesia maratima*, Linn. The examination of *Artemesia maratima* in 1921 in Dehra Dun showed that the leaves contained as much as one per cent. of santonin. With this percentage, it was financially profitable to work up the drug on a commercial scale, since the chemicals required for its extraction are cheap and easily available. It is said that the results obtained in this laboratory and the plentiful supply of *Artemesia* in Kashmir and the North-West Frontier Province, led to the formation of a santonin syndicate. No record is available to show why this syndicate had to close down and what the results were financially.

Dr. J. L. Simonsen continued to hold the post of the Forest Chemist till November 1924, when he retired. The study of the forest soils and related matters were more or less neglected during the years 1914—1925 and, therefore, need was felt for the creation of a post of Biochemist, in place of a Forest Chemist, and the services of Dr. J. N. Sen of the Imperial Agricultural Institute, Pusa, were requisitioned in February 1926. In 1926 and the following years much of the time was devoted to the study of forest soils in collaboration with the Silviculturist.

The Biochemist also interested himself in the study of indigenous drugs. *Adhatoda Vasica* was studied, and vasicine isolated. Later on, its constitution was elucidated and the results of this work were embodied in two papers published in the Journal of the Indian Chemical Society. Work on katha and cutch was taken up once again in connection with an enquiry from the katha factory at Bareilly. The great improvements in the quality and the quantity of both katha and cutch produced at Bareilly and at other places (Bihar and Madras) are due to information supplied by this branch.

In April 1928 Dr. Sen reverted to his original post at the Agricultural Institute, Pusa, and his place was taken by Dr. S. Krishna, in June 1928.

India is extremely rich in plants containing alkaloids of commercial value and the great variety of climates are suitable for the extended cultivation of alkaloidal plants. Up to the present only cinchona and opium have received any attention. In both cases, the cultivation and the extraction have been undertaken by Government.

During recent years ephedrine, an alkaloid present in several species of *Ephedra*, has found an increased application in medicine and the demand for it has increased. Formerly, China supplied the major portion of this drug, but owing to the disturbed conditions prevailing there, interest is now being taken in its supply from India. *Ephedra intermedia* and *Ephedra Gerardiana* from various localities in India have been found to contain more than one per cent. of ephedrine. This established the fact that *Ephedra*

Gerardiana from certain localities in India was richer in alkaloid content than the Chinese species *Ephedra Sinica* and *Ephedra equisetina*. Already a great demand for Indian *ephedra* has been created. America alone purchased 34 tons (918 mds.) of *ephedra* during the last 12 months. The alkaloid from 34 tons is worth nearly 4 lacs of rupees at current prices.

Aconitum Chasmanthum is well known medicinally and it finds a ready market in India and outside. It is sold at a price depending on its alkaloid content. Previous workers have never reported more than 0.5 per cent. of indaconitine even in the best of samples. Recently a sample was obtained from Kashmir which on analysis shows 1.6 % of indaconitine. The chemical constitution of indaconitine is now being investigated.

The results of investigations are published from time to time in scientific journals, memoirs, records, and bulletins issued by the Institute. Such publications do not, by any means, represent the total work of the branch, because much information and advice is given verbally and by correspondence to officers of the Institute and others.

OFFICERS WHO HAVE SERVED IN THE VARIOUS BRANCHES SINCE THE INCEPTION OF THE FOREST RESEARCH INSTITUTE IN 1906.

PRESIDENTS.

Name.	Designation.	Period.
. Eardley Wilmot	President, Forest Research Institute (in addition to being Inspector General of Forests.)	June 1906—Feby. 1908.
L. Mercer	... President, Forest Research Institute (and also Principal, Forest College.)	Feby. 1908—April 1909.

Name.	Designation.	Period.
A. M. F. Caccia ...	President, F.R.I. and College.	April 1909—Decr. 1909.
L. Mercer ...	Do. ...	Decr. 1909—April 1913.
R. S. Hole ...	Do. ..	April 1913—Octr. 1913.
L. Mercer ...	Do. ...	Octr. 1913—March 1916.
B. B. Osmaston ...	Do. ...	March 1916—Feby. 1919.
W. F. Perree ...	Do. ...	Feby. 1919—April 1920.
R. C. Milward ...	Do. ...	April 1920—Novr. 1920.
W. F. Perree ...	Do. ...	Novr. 1920—April 1923.
W. Mayes ...	Do. ...	April 1923—Novr. 1923.
W. F. Perree ...	Do. ...	Novr. 1923—Jany. 1925.
A. Rodger ...	Do. ...	Jany. 1925—March 1926.
Do. ...	Inspector-General of Forests, & President, F.R.I. & College.	April 1926—April 1927.
H. Tireman ...	Do. ...	May 1927—Decr. 1927.
A. Rodger ...	Do. ..	Decr. 1927 to date.

VICE-PRESIDENTS.

C. G. Trevor ...	...	Octr. 1926—April 1929.
C. E. Simmons ...	...	April 1929 to date.

SILVICULTURISTS.

Hobart Hampden ...	Silviculturist ...	April 1906—June 1906.
J. H. Lace ...	Do. ...	June 1906—July 1907.
H. H. Haines ...	Do. ...	July 1907—October 1907.
J. H. Lace ...	Do. ...	Octr. 1907—Feby. 1908.
A. M. F. Caccia ...	Superintendent of Working Plans.	July 1906—Feby. 1908.
Do. ...	Silviculturist and Superintendent of Working Plans.	Feby. 1908—April 1909.
R. S. Troup ...	Do. ...	May 1909—Dec. 1910.
Do. ...	Silviculturist ...	Jany. 1911—April 1913.
E. Marsden ...	Do. ...	April 1913—Feby. 1914.

Name.	Designation.	Period.
R. S. Troup	... Silviculturist	... Feby. 1914—March 1915.
E. Marsden	... Do.	... April 1915—Feby. 1919.
R. S. Troup	... Do.	... Feby. 1919—April 1919.
S. H. Howard	... Do.	... Octr. 1919—Feby. 1922.
H. Trotter	... Do.	... Feby. 1922—Octr. 1922.
S. H. Howard	... Do.	... Octr. 1922—Decr. 1925.
H. G. Champion	... Do.	... Jany. 1926 to date.

FOREST ECONOMISTS.

R. S. Troup	... Forest Economist	June 1906—April 1908.
A. J. Gibson	... Do.	... April 1908—June 1909.
R. S. Pearson	... Do.	... July 1909—March 1911.
A. Rodger	... Do.	... March 1911—Novr. 1911.
R. S. Pearson	... Do.	... Novr. 1911—April 1915.
C. E. C. Cox	... Do.	... April 1915—Octr. 1915.
R. S. Pearson	... Do.	... Octr. 1915—August 1919.
C. E. C. Cox	... Do.	... Augt. 1919—Novr. 1919.
A. J. Gibson	... Do.	... Novr. 1919—March 1920.
C. E. C. Cox	... Do.	... March 1920—July 1920.
R. S. Pearson	... Do.	... August 1920—May 1922.
W. A. Robertson	... Do.	... May 1922—Novr. 1922.
R. S. Pearson	... Do.	... Novr. 1922—March 1925.
H. Trotter	... Do.	... April 1925—Decr. 1925.
C. C. Wilson	... Do.	... Decr. 1925—April 1928.
H. Trotter	... Do.	... May 1928—Novr. 1929.

FOREST ENTOMOLOGISTS.

(Previously Forest Zoologists).

E. P. Stebbing	... Forest Zoologist	April 1906—April 1907.
C. E. C. Fischer	... Do.	... April 1907—Octr. 1907.
E. P. Stebbing	... Do.	... Octr. 1907—Decr. 1909.
V. Subramania Iyer	... Do.	... Decr. 1909—April 1911.
R. S. Hole	... Do.	... May 1911—Octr. 1911.
A. D. Imms	... Do.	... Octr. 1911—Feby. 1913.

Name.	Designation.	Period.
C. F. C. Beeson ...	Forest Zoologist	Augt. 1913—May 1916.
Do. ...	Do. ...	July 1917—Novr. 1919.
F. M. Howlett ...	Do. ...	Feby. 1920—July 1920.
C. F. C. Beeson ..	Do. ...	July 1920—May 1922.
Do. ..	Forest Entomolo- gist.	Novr. 1922—Jany. 1926.
D. J. Atkinson ...	Do. ...	January 1926—Decr. 1926
C. F. C. Beeson ...	Do. ...	Decr. 1926 to date.
M. Cameron ...	Systematic En- tomologist.	Decr. 1920—April 1923.
J. C. M. Gardner ...	Do. ...	July 1923—March 1927.
O. C. Ollenbach ...	Do. ...	March 1927—Mar. 1928.
J. C. M. Gardner ...	Do. ...	March 1928 to date.

FOREST BOTANISTS.

H. H. Haines ...	Forest Botanist...	July 1906—May 1907.
R. S. Hole ...	Do. ...	May 1907—April 1910.
C. M. McCrie ..	Do. ...	April 1910—March 1911.
R. S. Hole ...	Do. ...	March 1911—April 1913.
R. N. Parker ...	Do. ...	April 1913—Octr. 1913.
R. S. Hole ...	Do. ...	Octr. 1913—April 1914.
R. N. Parker ...	Do. ..	April 1914—Octr. 1914.
R. S. Hole ...	Do. ...	Octr. 1914—May 1919.
C. F. C. Beeson ...	Do. ...	June 1919—Novr. 1919.
S. H. Howard ...	Do. ...	Novr. 1919—Decr. 1920.
R. S. Hole ..	Do. ...	Decr. 1920—Decr. 1922.
R. N. Parker ...	Do. ...	Decr. 1922—April 1924.
S. H. Howard ...	Do. ...	April 1924—May 1924.
P. C. Kanjilal ...	Do. ...	May 1924—Septr. 1924.
R. N. Parker ...	Do. ...	Septr. 1924—Jany. 1926.
Do. ..	Do. ...	Novr. 1926 to date.
K. D. Bagchee ...	Mycologist	March 1927 to date.

Name.	Designation.	Period.
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FOREST CHEMISTS.

Puran Singh	... Forest Chemist...	April 1907—Octr. 1909.
B. O. Coventry	... Do.	... Octr. 1909—Octr. 1910.
Puran Singh	... Do.	... Octr. 1910—April 1918.
C. F. Cox	... Do.	... April 1918—June 1919.
J. L. Simonsen	... Do.	... June 1919—Novr. 1919.
A. J. Gibson	... Do.	... Novr. 1919—Mar. 1920.
J. L. Simonsen	... Do.	... March 1920—Septr. 1920.
C. F. C. Beeson	... Do.	... Septr. 1920—Jany. 1921.
J. L. Simonsen	... Do.	... March 1921—April 1924.
J. N. Sen	... Bio-Chemist	... April 1924—Feby. 1925.
Do.	... Do.	... Feby. 1926—March 1928.
S. Krishna	... Do.	... June 1928 to date.

SPIRÆA LYCIOIDES, PARKER.



SPIRÆA AFFINIS, PARKER.



SPIRÆA HAZARICA, PARKER.



INDIAN FORESTER.

MARCH 1930.

THREE NEW SPIRAEAS FROM THE N. W. HIMALAYA.

BY R. N. PARKER, I.F.S.

The discovery of *Spiraea hypericifolia* Linn. in Kashmir by Mr. W. J. Lambert has necessitated a re-examination of the specimens which had been so named in the Dehra Dun herbarium. There appear to be three distinct species which I have called *lycioides*, *affinis* and *hazarica*.

Before describing these new species it may be useful to give a key to the *Spiraeas* of the section *Chamaedryon* found in the Himalaya west of the Nepal border.

Buds short ovoid with several exposed imbricate scales—

Leaves greyish green, twigs terete *S. hypericifolia* Linn.

Leaves dark green above, twigs ribbed *S. hypoleuca* Dunn.

(= *S. diversifolia* Dunn.)

Buds pointed with two exposed valvate scales—

Leaves entire

Leaves thick, reticulate veins obscure *S. lycioides* sp. nova.

Leaves thin, distinctly reticulate *S. affinis* sp. nova.

Leaves mostly crenate or toothed

Leaves finely crenate or the smaller entire; inflorescence glabrous *S. hazarica* sp. nova.

Leaves coarsely crenate serrate; inflorescence hairy *S. arcuata* Hook. f. (— *S. Zabeliana* C. K. Schn.)

[In describing *S. Zabeliana* C. K. Schneider quotes as the types Duthie 2842 and 1106 e. Duthie had no specimens numbered 1106 e. and evidently 1106 c is intended.]

Spiraea lycioides Parker sp. nova.

Frutex, ramuli hornotini sparse puberuli, glabrescentes, vel ei validi steriles dense tomentelli, annotini puberuli vel glabri manifeste angulati, vestutiores striis decorticantes; gemmae 2.5-4 mm. longae, acuminatae, perulis dubus exterioribus glabris. Folia 2-3 cms. longa, 4-6 mm. lata, lineari-oblonga, integra, apice subacuta, crasse chartacea, supra et subtus concolor, subtripplinervia, glabra vel sparse pilosa, basi in petiolo circa 1 mm. longo sensim angustata. Inflorescentia umbellato-racemosa, circa 12-15 floris, in apice ramulorum brevium foliatorum; pedicelli 5-10 mm. longi, glabri; flores albi circa 7 mm. diam. Calyx extus glaber intus villosus, dentibus triangularibus intus villosulis; petala obovato-rotundata 3 mm. longa, irregulariter crenulata; stamina 20, petalis breviora; discus conspicuus, lobatus, lobis globosis; carpodia villosa, stylum paullo infra apicem gerentia, styli 1.5 mm. longi stamina dimidia aequantes. Folliculi in tubo calycis semi-inclusi, erecti, villosi, ventre gibbosi, dorso stylum erectum vel leviter incurvum gerentes.

Kashmir; Astor valley, Duthie 22nd July 1892 and 14th August 1892. Baltistan, Duthie 12015, Hunter-Weston 10202.

Hunter-Weston's specimens were collected in flower in June at an elevation of 2550 m. Duthie's in July and August in flower and fruiting at 3300-3900 m. Duthie quotes the vernacular name as *saber* and states that the wood is much used for making walking sticks.

This species is near *S. gemmata* Zabel but differs in having rather larger leaves, narrower and more acute buds, twigs more or less puberulous and much more hairy follicles. In *S. lycioides* the pedicels are furnished with bracts more or less leaf-like on the lower pedicels of the racemes, such bracts not being found in *S. gemmata*.

Spiraea affinis Parker sp. nova.

Frutex, ramuli hornotini glabri, annotini fusci manifeste angulati; gemmae 2.5-4 mm. longae perulis duobus exterioribus glabris. Folia 1.5-2 cms. longa 6-8 mm. lata, ea ramulorum sterilium duplo majora, anguste elliptica vel elliptico-oblongata membranacea, integra, glabra, obtusa, basi cuneata, subtus pallidiora, reticulata, nervis lateralibus utrinsecus 3-4; petioli 2-4 mm. longi. Inflorescentia umbellato-racemosa, 8-15 floris in apice ramulorum brevium foliatorum interdum fere sessilia; pedicelli circa 10 mm. longi, glabri; flores albi 8 mm. diam. Calyx-tubus extus et intus glaber, dentibus late triangularibus intus sparse puberulis; petala rotunda 3 mm. longa; stamina 40, longiora petalis subaequilonga; discus annularis crenulatus; carpodia sparse villosa, stylum paullo infra apicem gerentia, styli 1.5 mm. longi quam dimidia stamina breviores. Folliculi in tubo calycis semi-inclusi, erecti, pilosi, ventre paullo gibbosi, dorso stylum erectum gerentes, dentes calycis reflexi.

Hazara, Kagan valley, Inayat 21308.

Kashmir, Tattal nalla, Duthie 11100; Burzil valley, Duthie 14004; Minimarg, Gurez valley, Inayat 25592.

Has been collected between 2400 and 3600 m. flowering from May to July.

This species seems to be most closely related to *S. lycioides* from which it is easily distinguished by the broader thinner leaves which are reticulate beneath those of *S. lycioides* showing only the main lateral nerves. The stamens are twice as numerous but as some are imperfectly developed they probably vary in number. The disk also varies somewhat showing some tendency to being divided into separate lobes.

Spiraea hazarica Parker sp. nova.

Frutex, ramuli hornotini glabri sulcati, annotini fusci, manifeste angulati; gemmae 3-5 mm. longae acuminatae perulis duobus exterioribus glabris. Folia 2-3 cms. longa 10-13 mm. lata, elliptica, membranacea, integra vel apice versus crenulata, glabra, obtusa, basi rotundata vel paullo cuneata, subtus pallidiora, reticulata, nervis lateralibus utrinsecus 3-4; petioli 3-5 mm. longi.

Inflorescentia umbellato-racemosa, 15-18 floris in apice ramulorum foliatorum ; pedicelli circa 10 mm. longi, glabri ; flores albi 7 mm. diam. Calyx-tubus intus et extus glaber, dentibus late triangularibus intus tomentosus ; petala rotunda crenulata apice pleurumque emarginata 2.2 mm. longa 2.5 lata ; stamina 40-50 petalis longiora, discus conspicuus crenulatus et lobatus ; carpodia glabra stylum paullo infra apicem gerentia, styli 1.5 mm. longi staminis multo breviores. (Folliculi ex tubo calycis longi exserti, glabri, ventre gibbosi, dorso stylum patentem subapicalem gerentes, dentes calycis reflexi.)

Hazara : Kagan valley, Inayat 19398 ; Siran valley, Inayat, 19398a and without number 22nd August 1899.

This species resembles *S. affinis* somewhat but has broader leaves of a different shape and the larger leaves are mostly crenate. It seems to be more closely related to *S. arcuata* Hook. f. but is readily separated by its glabrous twigs and inflorescence. The fruiting specimen is rather poor and possibly does not represent the fruit properly.

**A DESCRIPTIVE ACCOUNT OF THE BAHRAICH
FOREST DIVISION, U. P.**

By D. DAVIS, I.F.S.

Bahraich is one of the northern districts of Oudh in the plains of the United Provinces, its headquarters station being about 80 miles in a direct line north of Lucknow, from which it is reached by rail in 6 to 8 hours by a somewhat roundabout route *via* Gonda. In the north it borders Nepal throughout its length of some 80 miles, the Himalayan foothills rising beyond the frontier, starting from the very boundary line in parts of the south-east, and gradually receding to a distance of about 30 miles in the north-west.

Bahraich Forest Division is a series of separate blocks in the north of the district. Motipur, which is by far the largest, occupies the north-west corner, while Chakia and Charda follow at short intervals, these 3 blocks all bordering Nepal. Bhinga,

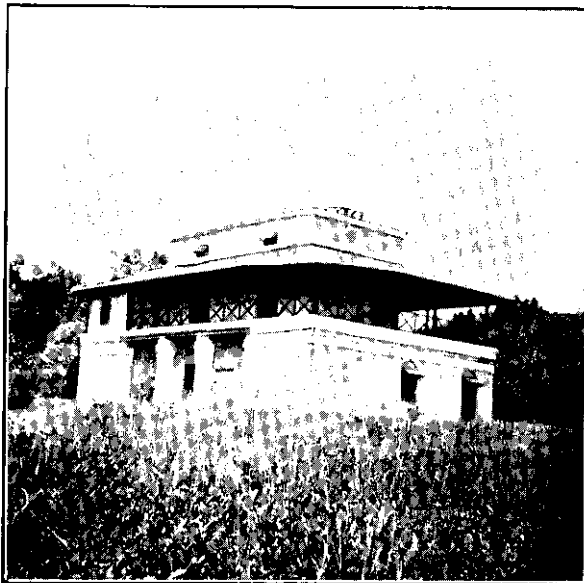


FIG. 1.—Nishangara Forest Rest House, Motipur Reserve.
On the edge of the sal forests.

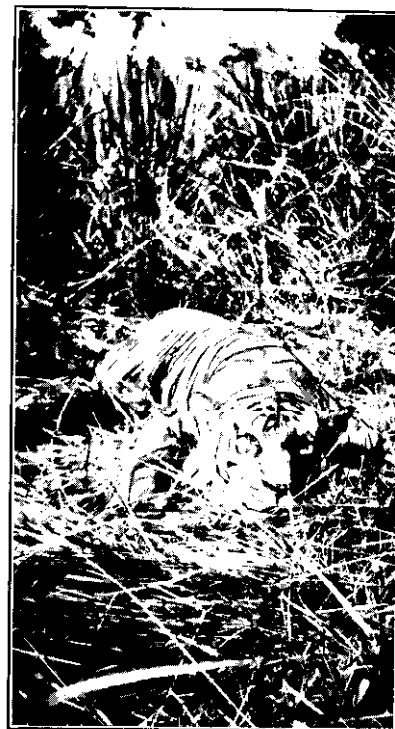


FIG. 2.—A heavy tiger beaten out of a
patch of high reeds in the hot weather.
The low-level grass lands of Katarnian,
Motipur Reserve.

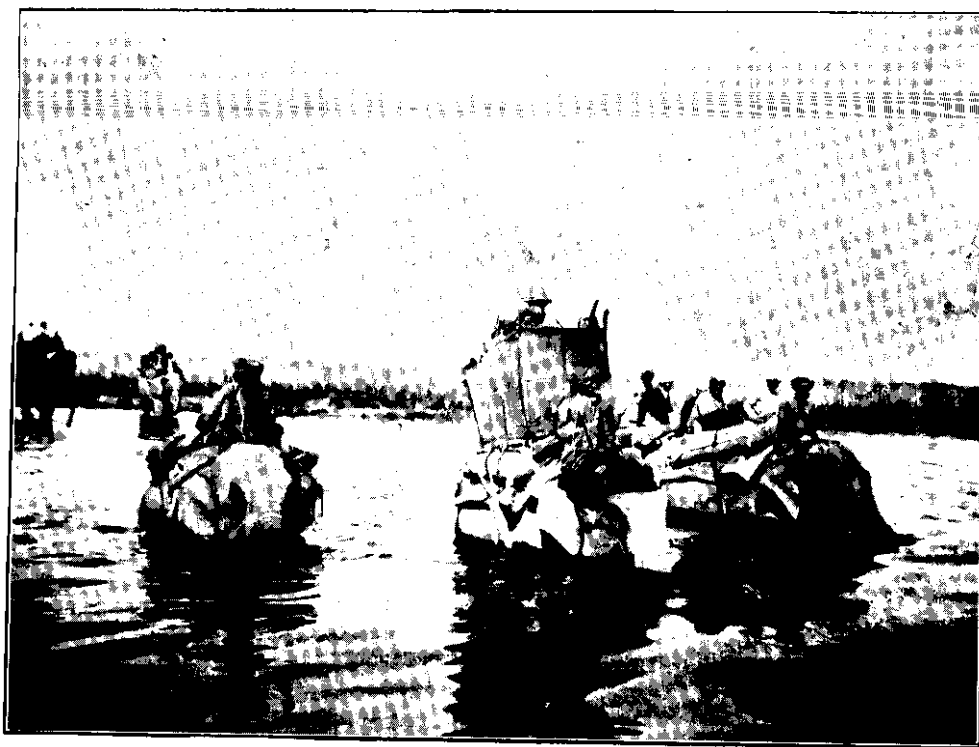


FIG. 3.—During a Xmas shoot in the low-level alluvial lands of Dharampur Reserve.

the last block to the south-east, lies a short way from the frontier, and Dharmanpur and Doaba are close to the western boundary of Motipur. The total area of the forests is only 276 square miles, but the distance by road from one end to the other is about 80 miles. Most of the forest areas are very accessible, as one branch line of the railway runs north from Bahraich and penetrates Motipur reserve, while another branch runs up to the Nepal frontier in between Chakia and Charda reserves. A good earth motor road runs from one end of the division to the other, connecting up with similar roads in the neighbouring forest divisions of North Kheri and Gonda. The forests commence at distances varying from 25 to 40 miles from Bahraich, and the connecting roads are motorable in dry weather, though not very good. Communications are thus good, transport by bullock cart is always possible, supplies are cheap and easily obtainable, and as the forests are dotted with rest houses at convenient intervals, camping can be done in comparative ease and comfort.

At the present day there is very little forest land in the district outside the Government forests. What exists is mostly in small strips and patches bordering our forests. But there is little doubt that large tracts in the north, which are now cultivated were under forest 100 to 150 years ago. On the other hand it is also probable that certain parts of the present reserves were at one time inhabited, and the remains of buildings and forts are often found in the middle of the jungles, and in several places tombs of reputed saints still exist, and are the scene of annual melas. Some of these forts are said to have been made by the local Rajahs in pre-mutiny days as refuges either from the attacks of neighbours or from the tax collectors of the Kings of Oudh.

Another interesting tradition has it that towards the end of the mutiny, when the Nana Sahib was hounded out from the scenes of his atrocities at Cawnpore, he fled through the Bahraich jungles into Nepal, and lived for some years in a remote valley in the foothills, where eventually he fell a victim to the dread fever of those unhealthy wilds.

It was in 1861 that our forests were taken over by the State, and they were created reserved forests in 1879. Very little

except demarcation and general protection and organisation was undertaken until 1893, when the first working plan was framed.

The main physical features of the northern part of Bahraich district in and near the forests are the 4 large rivers, the Kauriala, Girwa, Sarju, and Rapti, with more or less extensive low-lying alluvial tracts near them, and slightly higher plateaux in between. The general direction of these rivers is from north-west to south-east, and they all flow through or close to the forests. Geologically the forests are generally speaking on the alluvium of the Gangetic plain, and the soil varies from almost pure sand over large tracts near the big rivers to very stiff clay on many parts of the higher plateaux, and all intermediate soils are found. Rock of any kind is conspicuous by its absence, though shingle beds are found near the Kauriala and Girwa rivers, and *kankar* deposits also occur in the higher ground.

The climate of the forests is typical of that of the plains of Northern India, though the extremes of heat and cold are not so great as they are further to the north-west and further away from the Himalaya. From the beginning of November to the end of February the days are generally sunny and comparatively cool, and the nights are cold and heavy dews fall. From the middle of December to the beginning of February frosts may occur at any time, though they are not generally severe. In the hot weather, the shade temperature rarely goes above 110°, while the nights remain comparatively cool well into May, and sleeping out of doors a blanket may even be needed on exceptional nights at the very end of May. The monsoon rains may commence any time from the beginning of June until the beginning of July, and normally continue with varying breaks until towards the end of September. The average annual rainfall is about 45", 39" falling during the monsoon and 6" during the remaining 8 months. The forests are unhealthy during and just after the monsoon, and malaria is very prevalent from August to November.

The types of vegetation vary directly with the depth of the water level, and the type of soil. By far the most important tree is sal (*Shorea robusta*), which gives the division nearly three-quarters of its total revenue. Sal is confined to the higher

ground, occupying about 115 square miles of forests, and grows nearly pure, or mixed in varying proportions with other species, the chief of which is *asna* (*Terminalia tomentosa*). Other less important species found scattered throughout the sal areas are *haldu* (*Adina cordifolia*), *jigna* (*Lannea grandis*), *kusum* (*Schleichera trijuga*), *bahera* (*Terminalia belerica*), various *Ficus* species, and many others in small quantities. The undergrowth of shrubs is composed largely of *rohini* (*Mallotus philippinensis*), *bhant* (*Clerodendron* Spp. and *kasraut* (*Flemingia Chappar*).

A feature of the sal areas is the frequent occurrence in many parts of large areas of very poor soil with a pure clay pan a short way below the surface. The tree growth is miserable, the worst patches supporting nothing but *bel* (*Aegle Marmelos*), while on the slightly better areas *tendu* (*Diospyros tomentosa*), *khair* (*Acacia Catechu*), and occasional *haldu* and *bakli* (*Anogeissus latifolia*) are mixed with the *bel*. This type of forest occupies nearly 20 square miles. The remainder of the division (141 square miles) consists largely of the low-lying alluvial areas and other small areas of miscellaneous forests. In these are found extensive grass lands, interspersed with larger or smaller areas of miscellaneous tree forest and many trees scattered singly or in small groups. The most important species is *khair*, and there are large numbers of *semal* (*Bombax malabaricum*), *jamun* (*Eugenia Jambolana*), *haldu*, and various other species, including *sissu* (*Dalbergia Sissoo*) in small quantities chiefly on the more recent alluvial deposits.

Under the present working plan, which came into force in 1926-27, the main sal forests of Motipur and Chakia-Charda are managed under a system of conversion to uniform, while in the poorer sal areas of Bhinga and parts of Chakia the main idea is protection and gradual improvement with artificial regeneration where necessary. A feature of the Bhinga forests is a small working circle in which clear-felling and artificial regeneration by *taungya* has recently been successfully started. The grass lands and purely miscellaneous forests are managed as grazing grounds, while miscellaneous species are exploited as opportunity offers, though the demand for these is generally poor.

The gross revenue of the division is generally between Rs. 3,00,000 and Rs. 4,00,000 and the expenditure about Rs. 1,20,000, and as mentioned above nearly three-quarters of this revenue comes from the sale of sal timber and fuel. Bahraich is practically the only division in the United Provinces from which much timber is exported in the round, about 75 per cent. of the total outturn being taken out in the form of logs and poles, which are mostly railed to big depôts such as those at Bahramghat and Lucknow, where they are sawn up into the required sizes. Much of the timber actually sawn in the forest is in the form of metre gauge sal sleepers for the local railway.

Apart from sal, the most important species sold for timber are *asna* and *haldu*, while small quantities of *jamun*, *jigna*, and *baheera*, etc., are generally disposed of.

There is a good demand for *khair* for the manufacture of katha, as much as Rs. 35,000 being sometimes realised for one year's coupe of this species.

Various minor products find a ready sale, the chief of these being grass for thatching, rope making, etc., canes, *mohwa* (*Bassia latifolia*) flowers, and hides and bones.

The local inhabitants in and near the forests are almost entirely cultivators and cattle graziers. The yield from the crops is not generally very high, as apart from the poor nature of much of the soil, it is almost entirely dependent on a favourable rainfall. Cattle breeding is extensively practised, animals being bred both for draught and for the plough, and for the supply of milk, as there is a flourishing ghee and butter industry in many parts, notably near the Bhinga reserve.

The majority of the villagers are the usual type of Oudh peasant but in some of the villages near Nepal live considerable numbers of Tharus, of a type more Gurkha than Indian, both in appearance and characteristics. The Tharu is a cheerful soul, in spite of his precarious existence in the unhealthy jungles of the Tarai.

The Bahraich jungles provide excellent and varied sport with the rifle and gun, though the fishing is poor. The best all round

shooting is obtained in the various blocks of the Motipur and Dharmanpur reserves in the north-west. It is said that not so very long before Government took over the forests wild buffalo roamed the swamps near the Girwa river. This may have been the last home in the United Provinces of this fast disappearing animal. But strange as it seems now to think of buffalo in these comparatively "civilised" and accessible jungles, it will seem stranger still that a rhinoceros actually frequented these same areas for 2 years, and was eventually shot in December 1926. This particular animal wandered westwards, probably from the Gandak valley in Nepal, and the writer first got on its tracks in November 1924. During the ensuing 2 years its fresh tracks were frequently followed, but it was never sighted, and it appeared to spend the days across the border in Nepal, until in a moment of indiscretion it lay up one day in a small island belonging to a local zamindar, who promptly had it driven out and despatched it.

But to proceed with the sport that may normally be expected—tigers exist in fair numbers, this being due nowadays solely to the proximity of Nepal, where they breed undisturbed, and constantly migrate into reserved forest to take the place of those shot each year. The tiger in Bahraich is a more than usually nocturnal animal, and it is seldom that many are bagged by sitting up over kills and still less frequently is one seen by chance. This is no doubt because there are practically no really remote and undisturbed spots. Most tigers are therefore bagged in beats. They generally lie up in very thick patches of grass or reeds, and elephants are almost always essential, though it is seldom possible for the guns to be on the elephants, and the usual practice is for the tiger to be beaten up to *machans*.

Panthers are numerous in all parts of the division, and the sloth bear is fairly common, though it is confined to the Motipur, Dharmanpur, and Chakia reserves. About 6 years ago bears were so numerous that it was considered advisable to put a reward on their heads, and this has had the desired effect of reducing their numbers to normal proportions again.

Of deer, chital are found in large numbers almost everywhere, and carry heads as good as anywhere in India. Chital stalking in the low alluvial plains below the sal forest is excellent fun after the high grass has been burnt in the spring. Sambhar are mostly confined to the sal forests, and are nowhere very numerous nor do they normally have good heads. The gond or swamp deer is scarce, and is found only in the low-level areas of high grass and swamp. The kakur or barking deer in the sal forests, and the para or hog deer in the grass lands are also found, but not in great numbers.

Other animals worth mentioning are nilgai, which are common in the more open jungles near cultivation, black buck, which exist in fair numbers in some places, but have very poor heads, and pig which are numerous everywhere. Wild dogs, fortunately, are scarce, as the reward of Rs. 30 for their slaughter helps to prevent them increasing.

The jungles are well stocked with game birds, peafowl, red jungle fowl, black and grey partridges, green pigeon, and various sorts of quail are all common, while florican and swamp partridges also occur. Duck and snipe shooting is fairly good, especially in the numerous *jhils* and *tals* in the low-level areas of Motipur and Dharmanpur reserves.

It will thus be seen that the keen *shikari* will find very varied sport. The tiger can be bagged by the solitary sportsman, though this is difficult unless there are at least 2 or 3 elephants at his disposal, and as a rule to make sure of success it is advisable to have 2 or 3 guns and half a dozen elephants. Panthers can be bagged fairly easily by any of the usual methods, while chital stalking in the grass lands, or "still hunting" either on foot or on elephant back in the early mornings or evenings in the thicker jungles affords endless variety and amusement. One of the most amusing forms of *shikar* is the line of elephants in the low-level grass lands at Xmas, when anything from a tiger to a quail may get up, and there are places, more especially in Dharmanpur reserve, where very good sport may be obtained in this way, a good bag of peafowl, partridges, and hares being varied by an

hour or two of beating for swamp deer, and after lunch a duck shoot, while the line of elephants may easily put up a panther or hog deer at any time.

This account of Bahraich Division must, however, close with a note of warning concerning *shikar*. Modern conditions, easy communications both by rail and road, and increased facilities for shooting by gentlemen (and poachers) in all stations of life mean a great change for the worse for all true lovers of sport and wild life. One of the commonest forms of sport (so called) as practised by a good many permit holders nowadays, is to spend most of the day sitting in *machan* and having large blocks of forest beaten up to them by hundreds of coolies, and to spend a considerable part of the evening and early night rushing about in high-powered motors with strong spot lights and firing indiscriminately at every animal they see. The latter form of amusement is strictly against the rules, but is very difficult to stop. The eventual results, if this kind of modern "sport" is allowed to go on for long, are not difficult to imagine. It cannot be said that game has appreciably decreased in numbers yet, but it undoubtedly will, and it is already infinitely more difficult to find.

DANDELI AND ITS ACTIVITIES.

The village of Dandeli is situated on the left bank of the Kalinadi river in North Kanara, Bombay Presidency, about 19 miles from Alnavar, a main line station of the M. and S. M. Railway and is connected with the latter place by a metre gauge forest Railway which was completed in the year 1920-21 at a capital cost of Rs. 8,80,123. Dandeli, in itself originally a very small village, has greatly increased in importance with the advent of the departmental Railway.

The timber and other forest produce brought to this centre for sale and export is mainly derived from the forests of three Ranges of an aggregate area of 198·24 square miles, or 126,876 acres. These forests are the finest in the Presidency and second to none in India, being rich in timber of large dimensions and

high quality. Among the timbers disposed of annually at Dandeli, the most important and the largest quantity is represented by teak. Other well-known species include blackwood (*Dalbergia latifolia*), *matti* (*Terminalia tomentosa*), *nandi* (*Lagerstroemia microcarpa*), *hoddi* (*Adina cordifolia*), *tiwas* (*Ougeinia dalbergioides*), etc. These forests offer also a promising field for the manganese prospector, but owing partly to the slump in the market and the somewhat inferior quality of the ore and partly to the very unsatisfactory management on the part of the present lessee of the Shirol mines, the manganese business has been more or less at a dead-lock for the last two seasons.

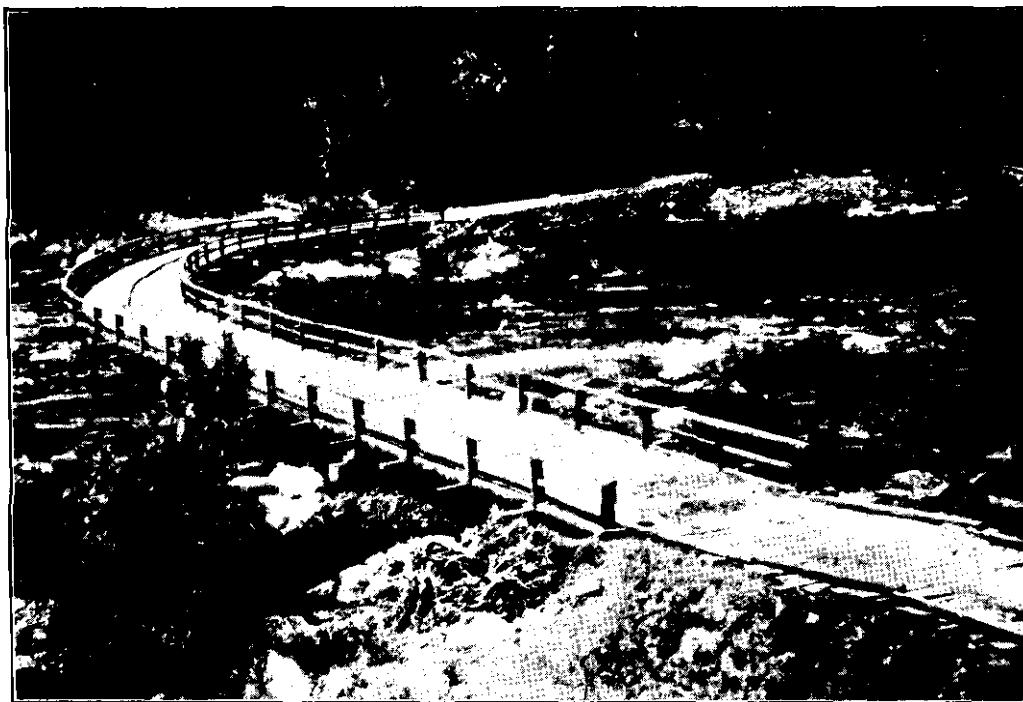
Accumulations of timber at this one depôt alone, out of several others in the Southern Circle, reached as much as 8,000 tons in a recent year; and it will be readily gathered that the energies of the forest staff are heavily taxed to collect, transport, measure, sell and despatch even half of this large volume of material year by year.

The average quantity of timber received at the depôt every year is about 5,000 tons logs, of which about 4,000 tons is teak. In addition about 1,200 tons of 6 feet teak pieces are handled every year for the supply of metre gauge sleepers to the Railways.

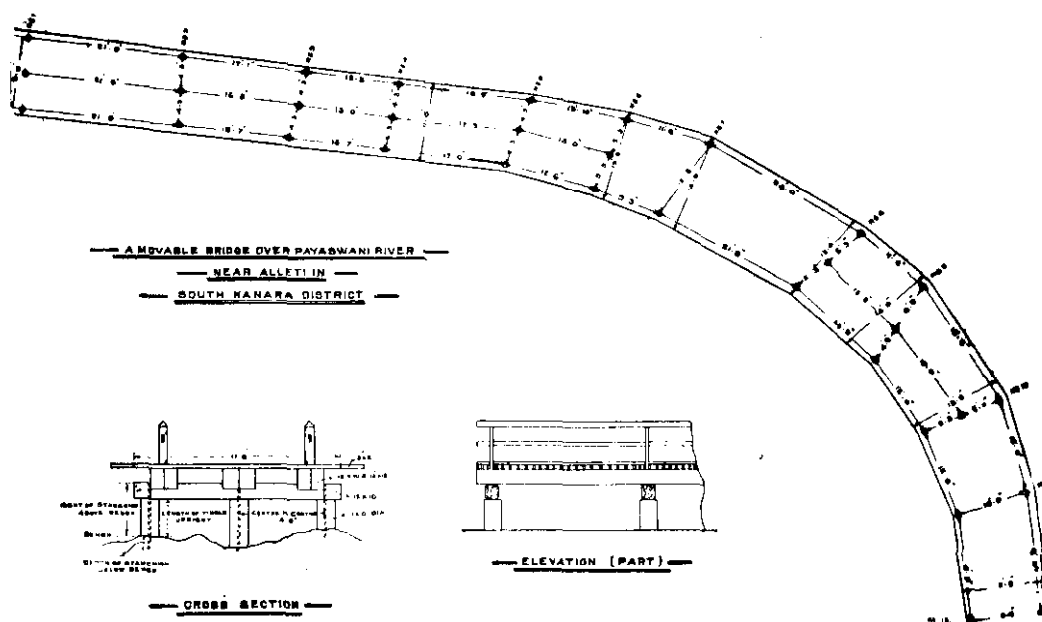
The average sale receipts for the Dandeli depôt during the last five years come to Rs. 3,86,217 and last year they were as high as Rs. 5,18,200.

Bamboos realise Rs. 25,000 an item which tends to increase. The forests of the three Ranges feeding Dandeli show a nett average annual revenue of about four lakhs of which about Rs. 80,000 is contributed by the sale of sleepers and scantlings converted from teak pieces sawn in the Government mills.

The Dandeli mills, as now constituted, are the largest of their kind in India comprising 2 large vertical frame saws, one American log saw and seven circular saw benches and allied machinery, the power being supplied by three steam engines of the well-known makes Fowler, Ransome and Robey. The excellent water supply is fed to the mill area, the railway, all Government quarters and coolie lines in Dandeli by forced pump



A movable bridge over Payaswani river.



feed from the river. A certain amount of the labour is provided by the Criminal Tribes Settlement, but the settlers prefer to work in the forest where they enjoy greater freedom.

The financial position of the Dandeli mill has markedly improved during the last two years, the net profit during 1928-29 being Rs. 1,70,843 and the total output 2,641 tons.

The above is a very brief description of Dandeli and its activities. With its humming mills, its row upon row of neatly piled logs, its numerous buildings, its shops, and its delightful surrounding forests, the haunt of the wild elephant, the bison, the sambhar and chital and the great carnivora, Dandeli is well worth a visit from the timber merchant, the sight-seer and the sportsman.

**SHORT DESCRIPTION OF MOVABLE BRIDGE
PARAPPA-MANGALORE SOUTH FOREST
DIVISION, SOUTH KANARA.**

BY C. S. MARTIN, FOREST ENGINEER, MADRAS.

The bridge is constructed in sections without the use of nails.

A stream bed showing either a rock out-crop or containing very large immovable boulders is a necessary corollary to its use.

Axe hewn caps are supported by round sections of timber, bored to fit the round steel anchorage pieces permanently set into the rock out-crop or large boulders. On these are placed sawn or axe hewn stringers capable of carrying the desired load.

The decking may be made of forest sawn planking, rejected sleepers or any other such material as is available. This decking is held down by bolts fastening the guard rails to the bridge floor.

Hand rails may be made of bamboo or small poles. Their value is moral rather than actual as they give bullocks confidence and tend to restrain them from jumping off the bridge if frightened.

The bridge may be given an irregular or curved location to fit the rock out-crops if necessary as it is only intended for slow traffic.

The only portion left in place during high water consists of the round steel stanchions let into the rock. These offer little resistance to floods and are usually too far beneath the surface to catch drift. If bent by rolling boulders they can easily be straightened.

**AN EXPERIMENT IN LAC PROPAGATION IN THE
BADAMI RANGE, DHARWAR-BIJAPUR
DIVISION, BOMBAY.**

BY S. S. DHARESHWAR, RANGE FOREST OFFICER,
BADAMI.

*(The previous article appeared on pp. 235 to 241 of the
"Indian Forester" for April 1928.)*

As the experimental work done in the season ending November 1927 was encouraging, the inoculation was extended from 212 hosts in three plots to 1,236 hosts in seven plots measuring about 21 acres in the following summer. The number of hosts was thus gradually increased until it reached 2,261 at the end of May 1929 on about 35 acres of forest. A variety of species were infected to ensure a successful crop. The mature female cells that infested the branches sparsely were left to swarm *in situ*, whereas the heavily infested branches were cut and the brood-sticks so obtained were put on to the same species as that to which the brood belonged.

As the brood-sticks obtained from the crop of *katki* (winter) season ending November 1928 were not found enough to extend the cultivation in the following season (December 1928 to June 1929) sufficient *basri* (*Ficus Tsiela*) brood was brought from the road side trees in Bagalkot. This brood was used in the case of the hosts other than those which were inoculated with the same kind of brood as the host species derived from the previous season's crop. As the larvæ drew nearer to maturity it was found

that most of them were males. It cannot be supposed that this phenomenon owed its origin to any fault in infection, because it was found that even in the case of the insects that swarmed in their natural condition on the *basri* trees in the season, the males were overwhelmingly preponderant. The predatory insect (*Eublemma amabilis*) was prompt enough to begin its ravages from the early stage of development of its host on the forest trees. Interchangeability of hosts which was tried did not seem to bring about any change for the better in the brood. It can be asserted that it is the peculiarity of the brood to produce mostly males in summer. This disadvantage coupled with the damage caused by the predatory insects resulted in a very poor yield. The damage was so appalling in the case of many trees that all the lac-growth was completely tunnelled through, leaving only a few dark thin scales here and there on the branches as the last vestige of the ill-fated lac-insects. The result of infection in the last *baisakhi* season shows that 2,261 hosts inoculated with 8,250 brood-sticks and bundles which also included 1,565 sticks left to swarm *in situ* could yield only 1,540 sticks from which the parasitised cells were removed, and the sticks so cleaned were used for infection again in the last month. The remainder of the crop *viz.* 4,410 sticks was rejected being very heavily damaged by predatory insects and consequently the yield in crude lac for the season amounted to only 12 lbs.

In the two *kalki* seasons about 50 per cent. of the infected hosts succeeded. Many of the hosts were small plants and had only one promising branch infected on each. One year old shoots especially of pollarded *khair* (*Acacia Catechu*) were found more congenial to the insects than tender and succulent shoots. It is interesting to note that they fared exceedingly well even on some unpruned old *khair* and other species and even on the thickest part of the *tugli* (*Albizzia amara*) stem. *Eublemma amabilis* was again conspicuous from August to October. In spite of the pest, the lac-insect seemed to thrive in the Anantpur and Ramthal plots, but when the crop was collected it fell short of the estimated yield by about 40 per cent. owing to the depredations wrought by the predatory insect. A pleasing feature of the

winter brood was that the encrustation on seven of the host species was thicker—being as much as $1\frac{3}{8}$ inches especially on *khair* and *wadiya*—than it was on *basri* itself. Photographs were taken before the evacuated lac-resin was crushed.

Fig. I shows a heavily infected *wadiya* bush (*Dichrostachys cinerea*). The white incrustated branches show how successfully the *basri* brood propagated on this species. The longest continuous encrustation in the season was five feet in extent on a *tugli*, whereas a continuous infection on a branch of *wadiya* was three feet and that on *ber* three and a half feet in length.

Fig. II shows a collection of well infested *wadiya* branches, the longest of which is three feet.

Fig. III shows healthy mature lac on seven different species which reached almost an uniform thickness. The scale in inches printed on the sides shows the thickness of the encrustation.

Judging the financial result of each season, both the 1928 and 1929 summer crops were nothing short of a failure. The winter crop 1927 yielded 36 lbs. of treated seed-lac from 212 hosts, three-fourths of which was granular and one-fourth dust or *molamma*. The sale proceeds from this quantity amounted to Rs. 22-0-9, whereas the expenditure on the work amounted to Rs. 35. In the last winter (July to November 1928) crop, out of the 1,270 hosts the lac succeeded in different degrees on only 533. The yield of crude lac was $42\frac{1}{2}$ lbs. which in its turn yielded $26\frac{1}{2}$ lbs. of treated seed-lac. This quantity as also $23\frac{3}{4}$ lbs. of *basri* stick-lac obtained from the brood used is expected to fetch about Rs. 30. The expenditure incurred for the work amounted to Rs. 43-8-0. The average yield of crude lac per successful host including the infected *basri* trees that form a lac nursery in Badami, is 3.2 tolas and when the yield of the six *basri* trees is considered the average per tree comes to $3\frac{1}{3}$ lbs. The maximum quantity of lac that a particular kind of heavily infected host

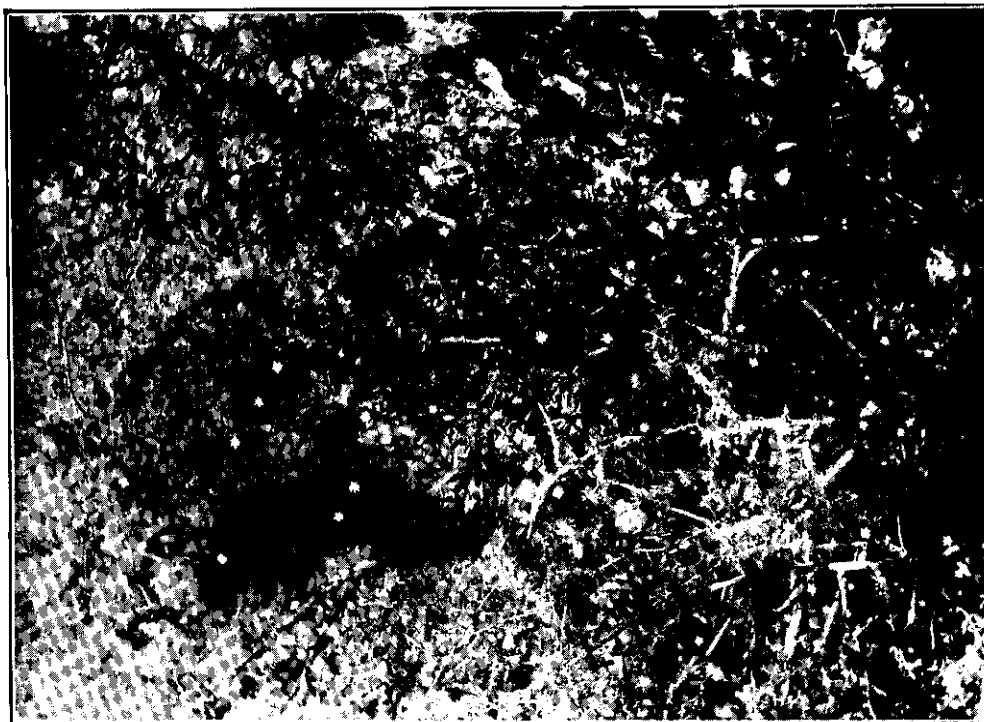


FIG. 1.—Heavily infected wadiya (*Dichrostachys cinerea*) shrub.
(The asterisks show the location of lac-infected twigs).



FIG. 2.—Well infected sticks of wadiya.
(The longest infested stick is three feet in length).

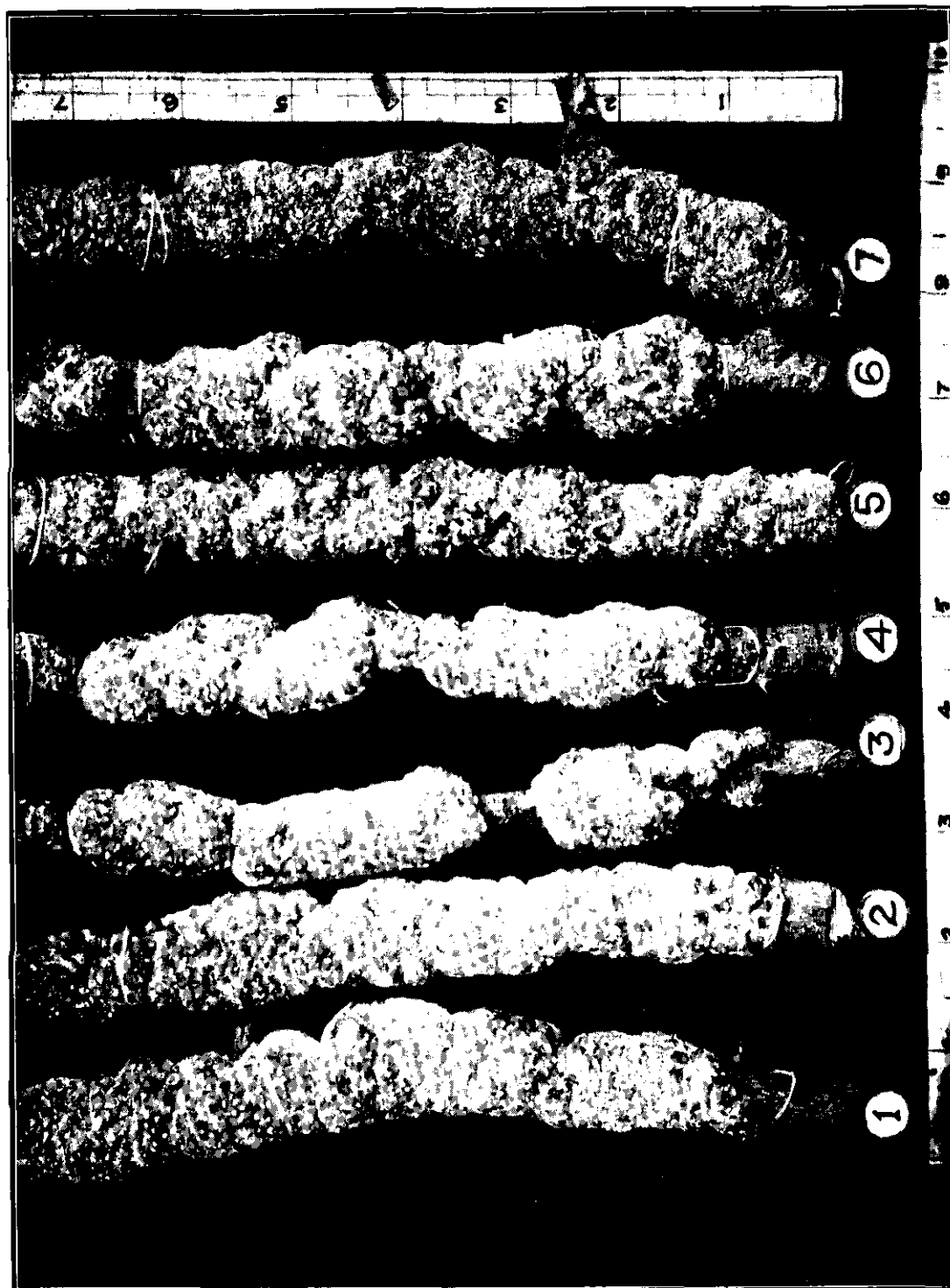


FIG. 3.—Fully developed lac on different species—
 (1) Wadiya, *Dichrostachis cinerea*. (2) Tugli, *Albizia amara*. (3) Khair, *Acacia Catechu*. (4) Shigi, *Acacia Intsia*.
 (5) Jali, *Acacia arabica*. (6) Hodjoli, *Acacia Latronum*. (7) Ber, *Zizyphus Jujuba*.
 The black spots on sticks show the holes bored by predatory insect (*Eublema amabilis*).

yielded in the season and the number of bundles it was infected with is shown below:—

Serial No.	Kind of host.	Max. yield of crude lac.	No. of brood-sticks used.
1	<i>Khair</i> ...	8 tolas ...	5
2	<i>Wadiya</i> ...	7 " ...	4
3	<i>Shigi</i> ...	5 " ...	5
4B	<i>Ber</i> ...	15 " ...	20
5	<i>Hodjali</i> ...	4 " ...	5
6	<i>Tugli</i> ...	15 " ...	15
7	<i>Babul</i> ...	2 " ...	5
		56 tolas. ...	59 sticks.

Thus the best infected host could yield only a little over a tola of crude lac per stick used for inoculation. This unsatisfactory result is not due so much to the xerophytic nature of the host and the climatic conditions as it is to the ravages of the predatory insects. In the absence of the pest which damaged the lac the yield would have more than justified the expenditure incurred.

If any results can be claimed in regard to the experiment it is that the *basri* (*Ficus Tsiela*) brood is found to thrive very well on the six forest hosts in the following order of merit:—

(1) *Khair* (*Acacia Catechu*); (2) *Wadiya* (*Dichrostachys cinerea*); (3) *Shigi* (*Acacia Intsia*); (4) *Ber* (*Zizyphus Jujuba*); (5) *Hodjali* (*Acacia Latronum*); and (6) *Tugli* (*Albizzia amara*).

NEW YEAR HONOURS' LIST.

We offer our congratulations to the Members of the Forest Department who figure in the recent Honours' List published in the Gazette of India (Extraordinary) of 1st January 1930:—

KNIGHTHOOD.

Sir Alexander Rodger, O.B.E., Inspector-General of Forests, Government of India.

COMPANION OF THE INDIAN EMPIRE.

Harold Lancelot Newman, Esquire, Chief Conservator of
Forests, Bombay.

REVIEWS.

THE COMMON COMMERCIAL TIMBERS OF INDIA AND THEIR USES.

BY H. TROTTER, I.F.S. GOVERNMENT OF INDIA, CENTRAL
PUBLICATION BRANCH, CALCUTTA. PRICE RE. 1-12-0
OR 3 SHILLINGS.

The object of this useful little book is to put in a simple straightforward way a great deal of the technical information

collected at the Forest Research Institute, Dehra Dun, and already published. As the author states the bulletins issued from time to time rarely attract the ordinary layman and are little read by timber merchants. We are certain that this book will supply a much needed want in the trade.

A similar booklet was published by Mr. R. S. Pearson in 1912, namely, "*A Commercial Guide to the Forest Economic Products of India*." The present publication is by way of bringing Mr. Pearson's book up to date, in so far as timbers are concerned.

There is a special chapter on air seasoning which every Indian timber merchant should read.

We can thoroughly recommend this book to all who handle Indian timber.

**BRITISH HARDWOODS—THEIR STRUCTURE AND
IDENTIFICATION.**

BY L. CHALK, M.A., D. PHIL., IMPERIAL FORESTRY INSTITUTE, OXFORD, AND B. J. RENDLE, B.Sc., A.R.C.S., FOREST PRODUCTS RESEARCH LABORATORY. PRICE 5S.

*(Published under the Authority of His Majesty's Stationery
Office, 1929.)*

The Forest Products Research Bulletin No. 3, "British Hardwoods, their Structure and Identification" by L. Chalk, M.A., D. Phil., Imperial Forestry Institute, Oxford, and B. J. Rendle, B.Sc., A.R.C.S., Forest Products Research Laboratory, is one of the most useful publications of its kind which has yet appeared. The intention of the authors in producing this work can not be described better than by the following quotation from the Introduction:—

"A novice can learn the distinctive features of our common timbers in a few weeks and he will then be less likely to be deceived than anyone of far greater experience who 'knows' his woods instinctively. The structure of wood can be accurately described and remains unaltered under conditions which may

entirely change the external appearance of the timber. The aim of the present publication has been to describe the structure of all hardwoods grown in the British Isles which are of any economic importance, apart from fuel, so that they can be identified with no further apparatus than a sharp knife and a simple magnifying glass or hand lens".

The scope of the work is, moreover, well-defined in the following statement also taken from the Introduction :—

"In both the descriptions and the key only those features have been included which can be seen on a clean-cut surface with the unaided eye or with a lens of a magnification of eight to ten times. Features only visible at higher magnifications have been omitted, as the use of a microscope is not generally practicable. It should be realised, however, that the examination of prepared sections under a microscope is always more reliable and is often the only certain means of distinguishing closely allied woods, such as willow and poplar."

The book may be divided into four parts: first, a general description in very clear and concise language of the structure of the wood, and of such technical terms as are absolutely necessary in the second portion of the report, which comprises illustrated descriptions of the woods. The photomicrographs in this part are good, though a few show a tendency to woolliness and lack of detail, and it is evident that more than one technique has been followed in the preparation of different species. It is unfortunate, however, that while most of the photomicrographs have been placed in the conventional manner (*i.e.*, so that growth proceeds from the bottom towards the top of the picture), a few have been placed in the inverted position, the portion towards the centre of the stem being placed uppermost.

The descriptions accompanying the photomicrographs are good, presenting the essential features without becoming verbose. It is probable, however, that some observers will not agree that in the case of elm (*Ulmus campestris* L.), the soft tissue is "not distinct with a lens". Under pear (*Pyrus communis* L.) also the statement "cuts equally well in all directions" is liable to be

misunderstood. It is hard to conceive of any wood which really cuts equally well in *all* directions.

The weight of walnut (*Juglans regia* L.) is, I think, placed rather high at 38 to 48 pounds per cubic foot at 12% moisture content. It is probable that 35 to 45 pounds per cubic foot in the specified condition of seasoning is nearer the mark. These are, however, minor details, and no one should have any difficulty in identifying any of the species dealt with by the help of these photomicrographs and descriptions.

The third part of the book presents a short Key for the Identification of British Hardwoods, and the fourth part a Select Bibliography with a short description of the scope of each publication mentioned.

Altogether, this bulletin is a valuable addition to the literature on the subject, and will prove most useful to all persons who have to deal with the British Hardwoods.

L. N. S.

ANIMAL ECOLOGY.

BY CHARLES ELTON, SIDGWICK AND JACKSON, LTD.,
1927. PRICE 10S. 6D.

Here is a book that will assuredly appeal to all those of us who are interested in the fauna of the country we live and work in, particularly just now when the inter-relation of big game and forest regeneration is so much to the fore.

We have rarely kept a volume for review so long on the table as this one under review. This is not because of any inherent forbiddingness in subject or presentation, but because we found it so full of interest that we felt it deserved reading more than once before comment was justified. The Editor's introduction—for this is one of a series of text books on Animal Biology, edited by Prof. J. B. Huxley—should not be missed, as it points out the position into which the book falls among extant literature, helping to fill a most important gap as it does. The

literature on plant ecology is already vast—some there be who think it somewhat too vast—but the works on general animal ecology are so few that the very term will not at once call up a very definite picture to the majority of our readers. Mr. Elton surveys the field most effectively, and the result is of the greatest interest to all biologists. Forest officers have exceptional opportunities for contributing to the general sum of knowledge of a most fascinating subject, as they will realise on reading the book; further, from them might well come the new ideas of real value in this young science (cf. p. 7)—and even *exciting* ideas (p. 33).

The style of the book is eminently readable (would that this were the case with more of the works on plant ecology!). Technical terms are successfully avoided, whilst very appropriate examples, apt quotations, and pithy comments are liberally sprinkled in. Thus it is explained how ecology consists in more than “saying what everyone knows in language nobody can understand,” and we learn that there is “more ecology in the Old Testament or the plays of Shakespeare than in most of the Zoological text books ever published” (p. 7); also that “while ecological work is fascinating to do, it is unbearably dull to read about.” (The author is far too modest here for he has disproved this last statement completely, and were it literally true, he must have plumbed great depths in working through the 152 publications he cites!)

Chapter II on Ecological Succession is full of interesting but not very generally known details and examples. The close connection between the plant and animal communities is well brought out, changes in one being surely followed by changes in the other. Here the forester will find the general principles illustrated from forest phenomena. An important point brought out in chapter IV on Environmental Factors, is that the animals themselves are a part of their own environment, a point very commonly forgotten. The complexity of factors determining animal distribution is also dealt with and intriguing problems suggested.

Chapter V, entitled the Animal Community, opens with a Chinese proverb to the effect that “One hill cannot shelter two tigers.” Four ideas are developed, *viz.*, food chains, sizes of food,

niches and the pyramid of numbers, as general principles regulating animal communities, of these the last two require an explanatory note. The term *niche* is used to indicate the function of the animal in its community, *i.e.*, not what it looks like but what it is doing; all communities are much the same in different habitats though the species occupying the several niches are different—thus in every community, there is a niche for carnivores and another for scavengers. We cannot refrain from quoting from p. 64.—“When an ecologist says ‘there goes a badger,’ he should include in his thoughts some definite idea of the animals’ place in the community to which it belongs, just as if he had said ‘there goes the vicar.’ The pyramid of numbers refers to the fact, that the higher an organism stands in a food-scale, the less numerous can it be—illustrations being largely taken from the bigger carnivores. Thus there cannot be as many tigers as there are deer for them to live on.”

Parasites come in for special treatment (Chapter VI), and then the time factor in animal communities is considered before what we may justifiably term the *pièce de résistance* is taken up, to wit, the Numbers of Animals. To make extracts from the 45 pages devoted to the subject presents all the difficulties of random sampling, and the whole should be read. The Rothamstead counts demonstrating the evidence (*inter alia*) of 800,000 earthworms and 1,500,000 flies per acre of arable land, may not be known to everyone. The tales of ‘the domestic cat in two of its wilder moments,’ with reference to cats, rats, and rabbits on small islands, should not be missed (p. 114), nor the demonstration that an increase in the number of sealing vessels may result in an increase instead of a decrease in the number of seals (p. 121). May we parallel the last with *shikaris* and deer in some parts of India? The principle of optimum density for a species is also one in which forest officers may well be interested (p. 115).

The subject of Dispersal is carefully analysed and the need of records of all observations bearing on it is stressed. This and the last subject referred to above seem to us to require a period of intensive collection of data such as systematics and plant communities have already had, to provide the master minds with

the profusion of data required for the safe deduction of the underlying general principles.

Finally we get a chapter on Methods and one on the bearing of Ecology on the theory of evolution. The former is a difficult matter to write up, as the author has himself admitted in his introduction; at the same time there are some useful tips and warnings. With regard to the latter, the author inclines to the opinions that most so-called adaptive colours in mammals are not actually adaptive at all. (Have not most of us seen the tiger against a green or dark jungle background?), but he has no doubt but that ecological work is absolutely essential for a solution of certain aspects of the problem, a conclusion with which we should find little difficulty in agreeing.

In conclusion, the book also deserves strong commendation for its get-up. A logical arrangement of chapters, each with a one-para. summary referring by number to each included paragraph (a difficult feat, this); a wide and well selected list of references to literature; an adequate index with the chief references differentiated; and thirteen good photographs from an extremely wide range of latitude and longitude, each aptly illustrating some point in the text. It is long since such value has been available for half-a-guinea and our thanks to Mr. Elton for giving it to us should take the form of recording our notes on the subject he has made his own.

H. G. C.

THE THARRAWADDY AND ZIGON DIVISIONS, LOWER BURMA.

An interesting note on these two well-known forest divisions, by Mr. Blanford, Conservator of Forests, Hlaing Circle, Burma, has been printed.

Tharrawaddy has long been known to possess forests which produce perhaps the best teak in Burma, and the methods of regeneration of teak here commented on are of great interest.

Mr. Blanford lays stress on the following points :—

1. Good organization for the whole work.
2. The extreme importance of obtaining a complete stocking of vigorous seedlings the first year.
3. The regeneration plan may be for ten years, but arrangements should be made in the felling *cum* regeneration plan for stockmapping, girdling, and extraction on areas to be regenerated after the ten years.
4. Systematic collection and distribution of seed.
5. Teak seed germinates best when crowded together.
6. *Nurseries*.—"After a careful study of all nurseries seen, I have come to the conclusion that we ought to know more about how to ensure early and even germination of teak seed. Germination seems to vary with soils and localities, quite apart from the actual date of sowing."

7. *Transplanting Teak Seedlings*.—"I consider this of the greatest importance. I have seen cases this year, where a barely sufficient stock of seedlings in nurseries was being wasted by being planted out anyhow. Such planting leads to waste of time of *taungya* cutters and waste of the strongest and best seedlings. It also results in weakly seedlings. The great difference careful planting makes was shown in one *ya* in Zigon Division. I noticed that at practically every stake, there was an exceptionally strong healthy seedling. This was a contrast to most of the other *yas*, where the *ya* cutter had planted seedlings anyhow with bare and damaged roots and often too deep. In this particular case, when the *ya* cutter was told to transplant a seedling, he went to the nursery and lifted it with a large ball of earth and planted it at a stake without disturbing the roots in any way. There was little wonder that his was the best *ya* I saw anywhere. Of the actual work in the *ya*, there is nothing more important than this transplanting; labour is wasted by the necessity of constant replanting, the strongest early germinating seedlings are wasted and, above all, seedlings do not get that start before the paddy really gets up that is essential if a

stocking of vigorous seedlings is to be obtained. Once staking is completed the attention of the subordinate in charge of the regeneration area should be concentrated on supervising *ya* cutters' transplanting."

8. *Accessory Species*.—"Another practice in Tharrawaddy which has been criticised is the planting of *maukadon* (*Sarcocephalus cordatus*) in swampy bottoms. Results in earlier plantations where this was done confirm me in my original belief that this is an advantage. Most of these swampy areas planted with *maukadon* are now well stocked with a complete canopy and join up with the canopy of the rest of the plantation. Surely this is better than leaving them unplanted or planting species which cannot grow in such localities and having an open grassy blank full of weeds which only tends to increase the waterlogged condition! I do not advocate planting up large blanks; these are best left entirely alone; but I do believe in planting up small swampy areas up to a chain or so wide."

EXTRACTS.

SIR SAINTHILL EARDLEY-WILMOT.

Sir Sainthill Eardley-Wilmot, formerly Inspector-General of Forests in India, died suddenly yesterday after returning from a drive to his home, Polegate Cottage, Henley-on-Thames.

Sainthill Eardley-Wilmot was born in July, 1852, the fourth son of the late Augustus Hillier Eardley-Wilmot. He joined the Indian Forestry Service in 1873 as Assistant Conservator in the North-West Province and Oudh, and after promotion to Deputy Conservator in 1882 and Conservator in 1891, he was transferred to Burma at the beginning of 1900. Three years later he was officiating as Inspector-General of Forests, and in the next year he was confirmed in that appointment, which he retained until his retirement at the end of 1908. On his return to England he became one of the Commissioners under the Development Act.

Firmly convinced of the value of scientific forestry to the agriculture and industry of India, Sir Sainthill Eardley-Wilmot did much by his zeal and enthusiasm to secure recognition of the increasing importance of the forest officer's work, and under his advice the Department made great progress on lines adapted to the growing needs of the future. The organization of the service was improved and its staff strengthened. Provision was made for the better education of forest officers trained in India, and the foundation was laid of a system of systematic research which has since been much developed. On his retirement Lord Minto's Government placed on record its appreciation of his assistance in the conservation of the forests and the value of the advice which his extensive tours had enabled him to give. His services were recognized in a C.I.E. in 1908 and in promotion to K.C.I.E. in 1911.

Sir Sainthill was a great sportsman, and during his service in the United Provinces and Burma no fewer than 130 tigers fell to his gun. He wrote a fascinating book entitled "Forest Life and Sport in India" (1911), and this was followed soon after by "The Life of an Elephant" and "The Life of a Tiger." In these he wrote the imaginary history of an elephant and the imaginary life of a tiger, forest born and bred but subsequently captured and tamed. He was twice married, and is survived by his second wife and by one daughter of each marriage.—(*The Times*)

THE ORLEANS NATURAL HISTORY TROPHIES.

A WORLD-WIDE RECORD OF BIG GAME AND AN UNRIVALLED WORK
OF BRITISH TAXIDERMY.

By Frank Wallace.

The late Duke of Orleans bequeathed to the French Nation the collection of big game and natural history trophies which it had been the great

interest of his life to collect. The majority of the specimens he had secured himself, and now that they have been moved from Brussels to their permanent home in the Rue de Buffon, adjoining the Jardin des Plantes, Paris, they present a spectacle which is, so far as I am aware, unequalled either in Europe or America.

Many of the African specimens are new to science, others are records in size, whilst the collection is of interest generally as being the largest collection of trophies in existence shot and collected by one individual. The fauna of Africa, India, Europe, North and South America, and the Arctic are very fully represented.

We hear much nowadays of the lavish expenditure of American museums and the care and pains which are rightly taken, even to the extent of moving wholesale, portions of the immediate foreground required, to ensure accuracy in the grouping of specimens of natural history which form a feature of these collections.

We in these islands, may justly claim to have been the pioneers in most of the hunting grounds of the world, and our American cousins would be the first to acknowledge the debt which they owe to their predecessors. It should be a matter of pride to all those who take an interest in such matters to realise that this splendid and unique collection in Paris has been set up, arranged and all the groups modelled by an English firm, without whose energy and experience it is not too much to say that it would not otherwise be in existence.

The work was begun more than 30 years ago—a small portion of the original background to the Arctic scene carries one's thoughts to those which must have filled the Duke's mind at its inception—before groups of animals had ever been heard of in America, and to Rowland Ward's is due the credit of having inaugurated what must, in the future, be recognised as the only effective and satisfactory manner in which to exhibit natural history specimens.

Certain developments suggest themselves, for instance, the background of part of the African section could be improved by the blending of rocks from which the group of lions is emerging, but this would involve much greater space and heavy additional expense. With the limited space at their disposal, Mr. Burlace, the managing director of Rowland Ward's, and his highly skilled staff, could scarcely have bettered their achievement.

For space is there, the space which we who have followed the great game into their own haunts yearn for in our dreams, and the memory of which never leaves those who have known it. We are back again on the open veld watching the slender necks of the giraffes topping the trees, watching the old bull kudu silhouetted against the dawn, or the little dik-diks springing from the tufts of grass at our feet. They are all there. The great white rhino and the hippopotamus, a kob pawing the ground, the beautiful Mrs. Gray and a group of situtunga down by the river reeds.

Duiker, oribi and the bigger bucks, tiang, hartebeest and water bucks with all the strange birds and river beasts which haunt the solitudes such as crocodiles, tortoises, pelicans, cranes and scissor bills. Then we leave the Sudan with the Duke's tent standing empty by the camp fire, and the newly-cleaned skulls beside it, and find ourselves by a step in Kenya.

A PICTURE OF A GROUP.

Here is a group of monkeys. Almost one seems to hear their chatter. A hyæna slinks off at the approach of a leopard, while a water buck stands at gaze. There a hartebeest is drinking, whilst another walks slowly off. A Grant's gazelle watches them. Beyond, in the shadow of the rocks, a replica of the actual scene where they were shot, the shadowy forms of a group of lions emerge. Looking down on them from the crest of an anthill stands a klip-springer.

Beyond, in the tall grass which shrouds their massive bulk, are two buffaloes and the lance-like horns of a group of oryx, one of the handsomest of all the African antelopes. A giraffe, straddle-legged, in the peculiar, typical attitude of his kind, is drinking while his companion crops the top of a tree. Close by is a gerenuk, that strange, long-necked creature of which the Duke obtained the record specimen. Other gazelles stand near. A cheetah crouches in the background. On a bare patch of ground a giant lizard suns himself regardless of the spotted hyæna or the wild dog.

Considerations of space prevented exact geographical grouping, and a few of the specimens in the Kenya section were shot by the Duke in Somaliland, Soemmerring's gazelle, for instance, which is shown with a group of Grévy's zebra. At the foot of an antheap is an aardvaark or ant bear. Grouped near by are some Burchell's zebra, a lesser kudu, wildebeest, bushbuck, topi and a little family of impala. Further on are two Chanler's reedbuck and an ostrich near a nest of eggs. The rare forest hog is within sight of his less imposing relative the wart hog, while on the branches of the trees or clinging to the reeds and grasses are all the smaller birds. Various eagles, bustards, ibis, guinea fowls and marabout storks are seen in their natural surroundings.

The Arctic section, which precedes the African, is entered from the main hall. The centre group consists of five Polar bears and two cubs, whilst on the left are three musk oxen, walruses and various seals, of which two harp seals are the most striking. Norwegian specimens are included here. Two reindeer, four wolves, a wolverine, Arctic foxes, lynxes, otters and hares are shown, interspersed with groups of gulls, puffins, snowy owls, guillemots, etc.

In the main hall, which covers a very large area are hung heads and horns, including a good specimen of *Cervus megaceros*, the extinct giant Irish deer (measuring 10ft. 1½in. spread), red deer, roe, chamois, and innumerable other trophies represent the big game of Europe, India, North America and Africa, which it would be tedious to enumerate in detail.

South American specimens, many of them very rare, are arranged in two large cases, the maned wolf of the Andes being particularly noticeable. It is rare to find it in any museum, public or private. Round the wall are placed some of the rarer specimens, including the whale-headed stork (*Baleniceps rex*) which the Duke secured on his last expedition to the Sudan.

A BIG GAME HUNTING INCIDENT.

Other cases contain specimens of the extinct Wallachian sheep, capercaillie "calling," and an *ovis poli* ram being attacked by a snow leopard. The centre group consists of an Indian elephant on which a tigress has sprung, reaching the *howdah*. This incident actually happened when the Duke was shooting in India. The mahout was knocked to the ground, the Duke's rifle was broken, and to the day of his death he carried a scar on his wrist inflicted by the tigress's claw.

Other mounted specimens include an Abyssinian wolf, an American bison, a bongo from French Congo, an okapi, an Alaskan bear, Caucasian tur, giant panda and animals such as kangaroos, Japanese deer, wild cats, etc., which the Duke kept in captivity at Wood Norton and at Manoir d'Anjou, his house near Brussels.

The hunting trips undertaken by the Duke were as follows:

India and Tibet—1887, 1888, 1889; Switzerland, 1889; Caucasus and North America, 1890; British Somaliland, 1892-1893; Scotland, Andalusia, Tyrol and Carpathians, 1893, 1904; the Arctic regions, 1904, 1905, 1907, 1909 (including Norway, Spitzbergen, Greenland, Nova Zembla, Sea of Karn, Greenland and Franz Josef Land); Turkestan, Central Asia, Caucasus 1911; South America, 1913; Kenya, Uganda, Sudan, 1921, 1922; Sudan, Bahr-el-Ghazal, 1923; Red Sea, Dinder and Blue Nile, 1926.

In conclusion, it may be remarked that in these days, when before the advance of a relentless and utilitarian civilisation, the large fauna which originally existed in vast numbers over the greater part of the globe is being exterminated with greater or less rapidity, a museum such as that of the Duke of Orleans assumes a position of great importance.

In the space of a very few years it will be impossible for an individual, even though he be gifted with the opportunities and taste to indulge his fancies, to bring together such a collection of representative wild life as is here displayed, however much energy, experience and expense are devoted to the task.

Posterity will gain their knowledge of the appearance of the diminished remnants of the wild life which we have known from Zoological Gardens, museums and preserves. To the men who have brought such collections together and to the art which has preserved in them so striking an appearance of life their thanks will be due, even though they sigh for the opportunities which have been denied them, and for the romance which attaches itself to the days that are gone.—(*The Field*).

SOCIETY FOR THE PRESERVATION OF THE FAUNA OF THE EMPIRE.

SIR PETER CLUTTERBUCK JOINS THE COMMITTEE.

The Society for the Preservation of the Fauna of the Empire held its annual meeting on November 4th at the offices of the Zoological Society of London. Lord Onslow, the president, was in the chair.

The report of the executive committee showed a substantial increase in membership during the year—from a total of 486, including 411 ordinary members, to 750 of whom 663 are ordinary members. Sir Peter Chalmers Mitchell (vice-president), drawing attention to this encouraging growth in the society, said that a large part of it was due to the personal exertions of the chairman. (Cheers.)

The committee in its report expressed deep sympathy with the movement for establishing national parks in Great Britain. "We naturally urge," the report continued, "that such parks should be so chosen and so administered as to provide sanctuaries for the avi-fauna and such indigenous mammals as can be reasonably expected to have a permanent habitat therein." The action of the Government in appointing a special committee to examine the question had brought it into the sphere of practical politics and in due course the committee of the society would consider the advisability of offering evidence.

Sir Peter Chalmers Mitchell said that many different ideas of what a national park ought to be had found expression. There was strong backing for the idea that such parks should be largely devoted to the recreation of the public, and that the public should have free access to them at all times. Representatives of this and other societies specially interested in the preservation of animals and plants were now drafting joint evidence to submit to the special committee. The line they were taking was that, although they favoured the establishment of national parks for the amusement and recreation of the public, such a policy would be of very limited value for the protection of animals and plants. For this purpose sanctuaries in appropriate places were required, and the public right of access must be limited.

HUNTING FROM MOTOR-CARS.

On the subject of hunting in the Tanganyika Territory from motor-cars the report expressed indebtedness to *The Times* for having generously opened its columns to a discussion. Various correspondents had also furnished the committee with reports on the same subject. It was pleasing to note that the Government of Tanganyika had promptly taken steps to check any abuses of this nature. Incidentally, the discussion had also resulted in a consideration of what was probably a more important matter, the relations of natives to the indigenous fauna in that mandated territory; and it would appear that the subject needed careful review. The committee, however, had confidence that both the Colonial Office and the Government of Tanganyika would take a balanced view.

The Chairman added that he proposed to raise this subject in Parliament, in the hope that a useful discussion would ensue. It was not in any spirit of hostility to the Government that he wished to do so. He thought, indeed, that the Government and the Colonial Office could be relied on to take a very sympathetic view of the society's objects.

In reply to a member, who asked whether the use of aeroplanes as well as motor-cars in hunting was being considered, the Chairman said that they had heard of an aeroplane expedition starting out on a quest of the kind, but he believed that the aeroplane came to grief before the animals, and since then nothing more had been heard about it. He agreed that the point should be considered.

The report of the committee alluded also to a number of other subjects which had received attention during the year. The situation in the Federated Malay States afforded some anxiety, but as the matter was still *sub judice* it would be inadvisable to express a definite opinion. The committee felt, however, that many of the difficulties could be solved by the appointment of an experienced game warden. Satisfaction was expressed at the appointment of Mr. Rodney Wood as game warden for Nyasaland. The sub-committee appointed by the society to confer with representatives of the fur trade, and to study the increasing use of fur and its relation to the fur-bearing animals, was not expected to be in a position to report this year. Though the question of the indigenous fauna of India had been considered by the committee, the area was so vast and the conditions so diverse that much remained to be done before definite proposals could be made. The committee now had the advantage of some of the best advice obtainable on this question.

The report was adopted, and the meeting confirmed a change of rule permitting the committee to co-opt additional members. The chairman explained that the alteration would allow the committee to procure expert advice on many parts of the world. The following members were added to the committee under this new provision :—

Sir John Hewett (late Lieutenant-Governor of Agra and Oudh).

Sir Peter Clutterbuck (late Inspector-General of Forests, India).

Captain Keith Caldwell (late Acting Game Warden in Kenya and Uganda).

Mr. R. Page (a former member of the committee).

DOMESTIC OCCURRENCES.

BIRTH.

STARTE.—At Nasik, on 14th January, to Maisie (née Man), wife of H. W. Starte, I.F.S., Conservator of Forests, a daughter.

INDIAN FORESTER.

APRIL 1930.

TEAK-BEARING ROCKS.

BY J. D. HAMILTON, I.F.S.

In our Burma forests it is an every day occurrence to find patches of well grown teak with intervening areas devoid of this species—the soil meanwhile to ordinary observation remaining the same. On our sedimentary deposits teak so behaving is found on both sands and clays. In the latter case often associated with *pyingado* (*Xylia dolabriformis*) and *taukkyan* (*Terminalia tomentosa*). The same applies to the rocks of our older formations. In fact this patchy growth is the ordinary way in which teak occurs. It is very unusual indeed to find any extensive areas of more or less pure teak forest. But they do occasionally occur. Some thirty or more years ago extensive pure teak forests were to be seen on lands which are now paddy-fields. Many of these areas were even taken up as reserves but were subsequently given up to cultivation. Since however teak will form extensive pure forests in much the same way as it forms clumps and patches there would appear to be some unknown factor which particularly favours teak and, could that factor once be definitely known the treatment and cultivation of teak would be greatly facilitated. From geological investigations extending over many years I take that factor to be the presence of lime in the soil. Mere traces of lime appear to be of little value. The lime must be in assimilable form and in quantity. The action of the lime appears to be both chemical and physical and it is not required

Merely as food material. But this is a point for subsequent discussion.

It is well known that teak does not ordinarily favour clay yet some of our best teak is found on clay associated with *pyingado* (*Xylia dolabriformis*). Teak will only occur on clay when lime is also present. In certain formations the lime is found as gypsum (sulphate of lime). Both in the Pegu and Arakan Yomas there are quite extensive tracts where this mineral is embedded in the clay either as thin transparent sheets (selenite) or in an opaque massive or fibrous form. Organic matter decomposes the gypsum (C. sulphate) to C. sulphide and water then changes this to C. carbonate, a form admirably suited to tree growth. Where gypsum occurs teak is invariably found. The presence of gypsum also has a very marked effect on bamboos and, more especially on species of *hmyin* (*Dendrocalamus*) and *thaik* (*Bambusa*). In the presence of gypsum, or more correctly the calcium carbonate derived from it, the usually entangled clumps of these bamboos at once become more open, the culms come up much further apart with a marked increase in girth, thinner walls and hollow stems. Teak and bamboo are similarly affected by the disintegration of certain limestones interbedded with the clays. These occur, for all practical purposes, only to the west of the Irrawaddy in what is known as the Nummulitic group. The lime is not found throughout all the beds, in fact there is only one real ten foot bed of limestone and a few minor bands of shale with nummulites. It is where these are exposed that the teak comes in.

Perhaps eighty per cent. of our teak grows on sand. But here too the presence of teak depends on the presence of lime. In this instance it is a sand, which has been turned into a sand rock by the cementing action of calcium carbonate, binding the small individual grains of silica together. This is by far the most valuable rock we have. The beds vary from a few inches to many feet in thickness and occasionally carry ripple marks on their surface. There are in places many narrow bands of

NOTE.—The word lime is used in its popular sense as meaning any calcium salt and not the definite oxide Ca O.

this sand with other rocks in between. At times even a pure band of limestone will occur. Occasionally the cementing of the sand has been very thorough, the unweathered rock is very hard and breaks with a bright gleaming fracture suggesting a quartzite. Another peculiarity of the freshly broken rock is an unusual but not unpleasant smell. (I do not refer to the distinguishing smell of limestone when two pieces are struck together.)

Wherever the lime-cemented rock is exposed teak immediately appears and, quite unexpectedly so, in parts of the Kyaw Reserve, (Yaw Division). Large areas of this reserve are covered with a loose quartz gravel of great depth and support nothing but stunted *indaing* forest of very poor quality. But like oasis in a desert appear small patches of first class teak. These patches of teak are invariably found on outcrops of lime-cemented sand. And, should there be a depression where the outcrop occurs, the lime liberated from the disintegrating rock is not easily washed away and an exceedingly rich marl results. Even worm-casts from such areas give a strong reaction for lime. And trees grow not only in the soil but actually on the disintegrating rock itself. Teak under these conditions almost invariably has a clean lofty bole. I recorded on a tiny patch of lime-sand in the Kyaw Reserve a solitary stag-headed teak eight feet in girth with a clean sound cylindrical bole of forty feet. The surrounding trees were nothing but poor *indaing* with no tree over three feet in girth.

The lime-cemented sand is not of equal hardness wherever found. Some of the formations disintegrate much more quickly than others and it is the easily disintegrating variety that forms a deep soil suitable for the best grown teak. At times the cementing is so hard that the rock weathers very gradually and does not of itself permit of much soil forming as the disintegration barely keeps pace with normal denudation. Should, however, the bed under the sand rock be capable of holding the liberated lime conditions for teak at once become favourable. This is not an uncommon occurrence. Hollows and flats also permit the accumulation of liberated sand and lime, and teak of course comes in. I would, however, emphasize the point that mere depth of

fine soil without lime does not favour teak whereas even a shallow soil with lime does. The ideal of course is fairly fine soil, deep and with lime in plenty.

In the Kyaw Valley (Yaw Division) from Kyaw to Wabin, a distance of about five miles, is the basin of an old lake or inland sea. The beds here lie as originally laid down and exposures in the banks of streams give beautiful examples of undisturbed strata. The present topmost course is a lime-cemented sand. It stretches in more or less broken sequence from Kyaw to Wabin and rests upon a deep bed of blue shale. The sand is of a rather tough variety with ripple marks. Its own soil-forming ability through disintegration is very small and the shale in itself does not favour the growth of teak. Nevertheless, from Kyaw to Wabin there stretches for five miles a more or less pure stand of teak. This is due solely to the small amount of lime gradually liberated from the sand converting a few inches of the shale to a marl. And the teak too grows with roots only a few inches below ground owing to the inhospitable nature of the pure shale lower down. The teak, due to the shallow available soil, is small—only two to three feet in girth—but well formed and proportioned exactly like large teak of good growth. And so one prefers to call them miniature instead of stunted teak. The strong affinity of teak for lime is here very clearly indicated.

Another good instance of teak growing gregariously in the Yaw Division is between the villages of San and Kyi. Teak here grows like a weed and dominates all other growth. The rock is a quicker disintegrating lime-sand than that of the old lake basin in the Kyaw and the trees show better growth. Still, the teak is not at its best, as the sand is shallow and rests on a quartz gravel suited only for stunted *indaing*. That these teak areas will become *indaing* as soon as all the lime disappears is certain.

A bit further west in this same locality lime-sand occurs in depth and with it some of the finest teak in the province. This rock besides containing lime carries other minerals. I think there are phosphates and some green particles from field observations I took to be glauconite. In places these very rich sands

weather rose-pink. It is on very similar, if not identical sands, in the Pegu Yomas that our best teak is found.

Patches of good teak are also often found in what are called *thitkyin* forests in Burma. These forests constitute the flat land between stream beds and adjacent hillsides. Often as not they are silted stream beds themselves to which hill-wash has been added. These forests are usually free from all bamboo growth. Where patches of teak occur on these flats it will ordinarily be found that the lime has been washed down from the hillside immediately above and is easily traced. It is very convincing in places to see how the teak limits itself to this supply. Often at the foot of a teak lined spur, spread out fanwise, will be found a clump of well grown teak. But should the hillside beyond the spur be devoid of lime teak will be absent both from the hillside and its adjoining *thitkyin* forest. The soil of these *thitkyin* areas is ordinarily so even in texture and so alike in formation that teak limiting itself only to certain patches seems altogether inexplicable until we know its affinity for lime. Another example is found in the Yawdwin where the rocks in the streams are often rich in lime. Teak can here be seen springing up in the river beds themselves with such unusual associates as *calotropis* and *cutch*.

It now only remains to record the occurrence of teak where limestone rock itself is found. This is a matter of common observation and in some instances the tree may be seen clinging to the limestone itself in much the same way as it clings to boulders of lime-cemented sand. But the weathering conditions with limestone are very different. Limestones in Burma, where they occur alone and not in association with other rocks, do not yield good friable soils in the usual sense of the term. They tend rather to produce stiff red sterile clays of which the *terra rossa* that covers hundreds of square miles in the Shan States is a typical example. Strange as it may appear these clays are almost devoid of calcium salts and consist of the insoluble residual remains of the limestones themselves. Hence a limestone country is not altogether suited to the growth of teak. Only where hollows and depressions allow the redeposition of leached out lime are conditions favourable. If the elevation

permits teak usually succeeds in finding these spots. Some of the greatest contrasts in forest growth are to be seen on land where lime can and cannot be held. I have seen lime-fed depressions in the Ondwe Reserve, Yaw Division, with both teak and cutch easily attaining a girth of six feet and over, while within a hundred yards where no lime could be deposited the best growth was cutch scrub and no teak whatsoever. *En passant* I may remark that it must have been the Yawdwin which originally suggested teak and cutch plantations as here these two trees are often found associated naturally. The combination is somewhat accidental. The soil is ordinarily a sandy cutch soil but in places becoming impregnated with lime teak immediately comes in. The attempted combination of teak and cutch by plantations elsewhere has never proved a success as the same geological conditions could not be reproduced.

What has been stated above elucidates some of the hitherto obscure phenomena concerning teak. Old teak trees of large dimensions are often found growing on exposed ridges and at times elsewhere with no regeneration in the vicinity. Even the younger girth classes are often absent. This is nothing more than a clear indication that a lime impregnated soil no longer exists and has not existed for some time. At any rate, lime is no longer near the surface and, in consequence, teak is unable to establish itself. Similarly, in many instances lime leached from inside a reserve is redeposited on land just outside our boundary and then we have more teak reproduction outside than within the reserve. The forest boundaries on both sides of the Pegu Yomas and along the eastern slopes of the Arakan Yomas bear witness to this. If a block of the lime-cemented sand is put in a strong fire nothing but a very loosely held sandstone with grains of magnetite etc., remains. Moisture soon oxidize the iron which recements the sand and we get exactly the type of rock which supports *indaing*—a ferruginous sand rock instead of a calcareous one. These changes can easily be observed in the drier parts of the Pegu Yomas of the Yamethin Division.

Teak on soils from which the lime has been leached out often has a very thin bark which splits leaving the wood exposed.

This usually occurs near the roots but at times quite high up the bole. Fire gets a hold on the exposed wood and the tree either dies standing or is burnt or blown down. This bark defect is commonest along exposed spurs and crests where soil denudation is rapid. In such localities it will invariably be found that no teak regeneration of any consequence ever comes up and the existing trees put on next to no increment. In fact the area has ceased to be teak producing. It can in consequence be of no economic advantage whatsoever to try and maintain teak under these conditions and the sooner the remnants of teak found in such localities is removed the better. There is nothing to be gained by nursing and codling an impossibility.

As regards plantations, from what has gone above, it is obvious that teak should only be put down where the source of lime is in sufficient quantity to assure success. Of course teak can be introduced on to a great variety of soils. By planting, weeding, cleaning, thinning, fire-protection and other cultural operations the tree can be made to grow. But never will it have fast growth and a clean long bole without the presence of lime. The original seedling and sapling growth may look promising, but growth soon gets slow and the poles fork at a height of twenty feet or so and then flower and seed, which really means that all useful height growth has ceased. On the other hand if a plantation is made in a locality with good lime-cemented sand clear boles of forty to sixty feet will result and the growth will be very rapid. Under such conditions there would be no faulty plantations. There is also only one way of knowing the right locality for a plantation and that is by an examination of the rock. The behaviour of bamboos and other growth may be indicative, very often is, but they are not by any means infallible, e.g., *kyathaung* bamboos (*Bambusa polymorpha*) usually taken to represent good teak soil, can be found in plenty on *kanyin* (*Dipterocarpus* spp.) producing lands and yet such soil is not particularly suited to the growth of teak. *Kanyin* soil is usually very fine, binds hard and is deficient in lime. Teak on such a soil will not have good clean boles but will flute, twist, contort and fork early. Even good teak growth itself is

only indicative of the actual plot on which the teak stands as being suitable, a few yards one way or the other may mean failure. In fact this has already been stated in another way when referring to the patchy nature of our teak forests—a patchwork due to the uneven distribution of lime. It accordingly follows that really good ground suitable for but at the moment unoccupied by teak is really very scarce, teak already having occupied almost all suitable localities. Hence, whatever the silviculture we adopt for teak, its useful application is practically limited to existing good teak areas. And their extent is more than enough to absorb all our men and money. The areas given up to rice and other cultivation within our reserves are very often admirably suited to the formation of plantations. These fields are the depositories of our lime and once really supported teak forest. If teak were reintroduced it would immediately succeed. We are restricted to growing our teak in patches large or small, as controlled by our lime-holding geological formations. These formations too are not of a very permanent nature. Denudation in places is a very serious factor and new exposures of lime bearing rocks do not keep pace with erosions. Again, redeposition of lime rarely takes place within our reserves on any great scale—the mineral being usually carried out to cultivable lands beyond our boundaries where the more or less pure teak forests once stood. But even here all the lime is not deposited and large quantities find their way out to sea. Ground capable of holding our existing patches of good teak has never yet been given its full value. If it could be realised that they mean so much and no more but in all probability less teak land they would receive a higher appreciation. Ground at present holding teak will not indefinitely continue to support it. In many instances it has already ceased to reproduce it and in many others it is approaching this stage. Denudation and erosion of these valuable sands are not to be thought of in geological periods but by the short span of a teak tree's life. Even a foot of sand will support good teak. And it does not take long for a foot of sand to disintegrate and pass away. And the best lime-sands from our point of view are those that do readily disintegrate to form soil.

It is not easy to give the exact position of these sands in our geological strata. They occur in the Fossil-Wood Group of Theobald (Irrawaddian Sands of Pascoe), in the Pegus and Nummulitics. The best deposits I have seen are in the Pegus and in what I take to be somewhat older formations in the Arakan Yomas. But whichever series is taken these sands do not occur in exactly the same position throughout. This could hardly be otherwise under the conditions which led to our tertiary deposits. In places near the sea the strata underlying the topmost bed of the Fossil-Wood Group is a clay. It is exactly in this position that a lime-cemented sand may be found further inland. This is nothing more than that the heavier sand was deposited first and the finer constituents forming the clay settled further out at sea. A topping of gravel finally covering both.

I have as far as possible avoided mentioning the influence of lime on other trees as the intention has been to confine this note to teak. But in order to avoid the impression that teak alone benefits by an abundance of lime I would mention the marked effect lime has on *pyingado* (*Xylia dolabriformis*), *taukkyan* (*Terminalia tomentosa*), *cutch* (*Acacia Catechu*), *thinwin* (*Millettia* spp.), *pyinmana* (*Lagerstroemia* spp.), *thabye* (*Eugenia* spp.), *thitsi* (*Melanorrhoea* sp.), *tawthayet* (*Mangifera caloneura*), *binga* (*Stephegyne diversifolia*), *panga* (*Terminalia Chebula*), *myauklok* (*Artocarpus Lakoocha*), *sinbyun* (*Dillenia* spp.), and *dahat* (*Tectona Hamiltoniana*). All these trees grow much better in the presence of calcium carbonate. And more especially would I draw attention to *dahat*, the only *Tectona* other than teak in the province. Normally this tree is regarded as representing scrub jungle and fit only for firewood. It will probably surprise many, as it did me, to find *dahat* associated with teak on a lime-sand with girths of over seven feet and clear boles of forty feet. Nevertheless, however much the species enumerated above benefit by the presence of lime, should the rock be a sand, teak remains the dominant tree. But where lime (gypsum etc.) permits teak to enter on a clay the competition with *pyingado* and *taukkyan* becomes very acute, as they all appear to grow equally well.

In conclusion I would say that teak is really a migratory species following the depositions or outcrops of lime bearing rock—and that is the key to its silviculture.

THE COWDUNG PROBLEM.

BY M. D. CHATURVEDI, I.F.S.

[In his article published in the September number of the *Indian Forester* Mr. Mobbs examined in some detail Mr. Chaturvedi's solution of the cowdung problem which appeared in May 1929; in October 1929 Mr. Vahid wrote a short note.—ED.]

The idea of creating village plantations is as old as the villages themselves and can be traced to the Hindu Scriptures which enjoin every one to plant trees. More recently, fodder reserves constituted a special feature during the regime of Akbar the Great. Doctor Brandis (1873) and later Doctor Voelcker (1893) both emphasized the importance of fuel plantations in the village economy of this country. Many others have followed suit. But village forests existed only in old blue books and bulky official reports. It was not till 1912 that the United Provinces Government in their Resolution No. 348 outlined a scheme which aimed at the prevention of erosion of valuable agricultural lands by the Jumna, the reclamation of ravine land and the establishment of fuel and fodder reserves. The Forest Department has ever since concentrated on afforestation schemes dealing mainly with the reclaiming of ravine lands and the measure of success obtained is by no means meagre. A number of fine plantations have been created and the valuable experience gained has only demonstrated the vital importance of fuel and fodder reserves in the village economy of this country, in a manner far more convincing than the theoretical suggestions embodied in Journals of Agriculture and other research publications. Few as the existing village plantations are, they suffice to focus the attention on their importance in the possible elimination of cowdung from human hearths and consequent amelioration of village conditions which will be brought about by increased yields from fields owing to cowdung being used as manure.

2. Little, however, can be achieved in the way of a general establishment of the fuel plantations as a concomitant feature of agriculture in India, unless a sympathetic study of the cultivator's point of view is made and his difficulties appreciated. The villager, strange as it may appear to his critics, is fully aware of the fact that cowdung is more valuable as manure than fuel although he has no pretensions to the knowledge of its chemical constituents. But then he asks the obvious question, what is he to burn in his household hearths? To this question no practical reply has been forthcoming. Cowdung cakes made by women-folk in their idle hours provide the village with an inexhaustible supply of fuel which costs next to nothing. Obviously cowdung cakes can never be replaced from village hearths unless the impossible condition of supplying villages with free fuel is fulfilled. In a village in the district of Budaun I persuaded the Raja of Pilibhit, its owner, to let some of the cultivators have free fuel from his *dhak* (*Butea frondosa*) jungle hard by, with astonishing results. These cultivators saved their cowdung for manure and reaped a harvest they had never known before.

3. Village plantations would obviously be the easiest solution to meet the villagers' demand for free fuel, the only difficulty being their creation. Who is to finance such a colossal scheme?

4. The revenue system which obtains in these provinces does not encourage the *samindars* to take any interest in the amelioration of agricultural conditions. They generally get a fixed rental per unit area from the cultivators. It does not concern them in the least what the area produces unless it produces nothing at all. The State gets similarly a fixed revenue per unit area from the *samindars* and is equally unconcerned about what it actually yields to the cultivator. If fuel plantations release cowdung to be used as manure on agricultural fields, the entire benefit goes to the cultivator, and neither the *samindar* nor the State stand to any immediate profit, during one settlement period of 30 years at least. Under the circumstances it is impossible to arouse any interest among the *samindars* in the fuel-next-door-scheme. An appeal only to their philanthropy can hardly succeed when the creation of village plantations involves them in a direct

expense for which there is no visible return. A common source of complaint among the *zamindars* arises from their inability to realise their rental from the cultivators on account of their indifferent crops from unmanured fields. Owing to their chronic indebtedness and poverty, the tillers of the soil are unable to pay the *zamindar* his rental regularly. The *zamindar* has got to pay the Government whether he is able to realise his revenue or not. He has the option of getting the tenants who do not pay ejected or of bearing the loss patiently. The former generally involves delay and costly litigation. He usually prefers the latter. The only justification for the *zamindar* being interested in the matter is the indirect profit which the prosperity of the cultivators (arising from better yields from their well manured fields) secures in the shape of the fully realised rental.

5. The position of the Government, although similar to that of the *zamindars*, is more secure inasmuch as that their annual revenues are regularly realised except when a famine is declared. The State have, therefore, less incentive to concern themselves with the agricultural produce of land than the *zamindars*, as long as a fixed revenue is annually remitted to the treasury. Unlike the individual, the State, however, could be credited with the foresight to appreciate the possibility of an increase in the rental at the next revenue 'settlement' which the increased yields occasioned by manuring the fields will amply justify. Although the *zamindar* should not lose sight of an ultimate increase in his share as well, he may be excused for his inability to count an increase after a long period of 30 years or so—the settlement period. It might be permissible to remark here that the general welfare and prosperity of its people should be the primary concern of the State and the actual realisation of revenue should be considered as means to attain the object and not an end in itself.

6. Having dealt with the points of view of the cultivator, the middle man (*i.e.*, the *zamindar*) and the Government, we can now proceed to consider the scheme which I broadly outlined in the May number of the *Indian Forester*. Given sympathetic understanding of the situation, the utopia is easier of attainment than imagined. It is not realised that most fallow lands except those

of the worst type are allowed to remain idle not because they would yield nothing but for the sole reason that they would not yield enough to pay for the cultivators' labour, the *samindar's* rental, and the assessment of the State. The omission of the two latter charges would make many fallow lands not so unattractive a proposition as it would seem to be. What is classed as unculturable waste is really not always unculturable. More often than not its yield is not enough to cope with the demands of the cultivators, the *samindar*, and the State. The limiting point of the culturability of land is reached when it refuses to pay even for the labour expended on it. The fact that a land can not yield much more to meet the super charges imposed on it does not render it useless for the purposes of *taungya*. The *taungya* at Clutterbuckganj started by the writer this year includes some lands which were never cultivated before because they did not allow for a margin of profit sufficient to meet the super charges imposed on them.

7. It is not sufficiently realised what the country loses in cowdung used as fuel instead of manure. In 1908, Doctor Watson* calculated the manurial and fuel values of cowdung as 11 and 4 annas a maund respectively. Thus, every maund of cowdung burnt represent a criminal waste of 7 annas which a predominantly agricultural country like India can ill afford.

8. In his memorandum† submitted to the Royal Commission on Agriculture Lieut.-Col. R. McCarrison, the Officer-in-charge of the Deficiency Diseases Inquiry, stated that farmyard manure excelled all artificial chemical manures in improving the nutritive quality of food grains. It was found, for example, that chemically treated soils yielded wheat whose A—vitamine contents were 17 per cent. less than wheat obtained from soils treated with farmyard manure. In addition to the mineral constituents of their food, plants not unlike animals need certain organic substance known as 'auximones.' The function of these substances in

* Supplement to the *Indian Trade Journal*, X. August 27, 1908.

Quoted in *Young India*, June 13, 1929.

† Quoted in *Young India*, June 13, 1929.

the development of plants is analogous to that of vitamins in the normal metabolism of man and animals. Auximones are not only essential to the full development of plants but also add to their vitamin contents which makes them fit for human and animal consumption. The cowdung manure when acted on by a certain type of soil bacteria provides the most valuable source of auximones so indispensable to plant metabolism.

9. At a very conservative estimate, the qualitative and quantitative value of the yield from soils treated with cattle manure would be at least 50 per cent. higher than the yield from unmanured fields.* Thus, by employing the farmyard manure on the fields, 66 $\frac{2}{3}$ acres can be made to yield what 100 acres (unmanured) produce to-day. We have thus a surplus of 33 $\frac{1}{3}$ per cent. of the land at present under cultivation of which part will be available if necessary for creating fuel and fodder reserves over and above the culturable and unculturable wastes which are now lying idle. Needless to say, only lands which yield indifferent crops will be first included in the fuel-next-door scheme.

10. The real difficulty in launching the scheme will arise during the transitional time which fuel plantations will take in getting established. The choice of land for afforestation would obviously fall first on fallow lands; and if they do not suffice for fuel requirements of a village then a portion of land under cultivation will have to be acquired. No hardship attends the conversion of waste lands into plantations but the transference of fields to the area under plantations would mean a dead loss to the *zamindar* as well as to the State, as no revenue could be assessed on them according to the conditions of the *taungya*. Although the cultivator will get his crops in between the rows of trees, after 4 or 5 years he will have to give up his cultivation too, and will consequently suffer. The prospect of losing a portion of his land, however small, would be none too pleasant for him. The cultivator will, however, not be slow to visualize the benefits which will ultimately accrue to him from forest plantations in the shape of free fuel and fodder for his cattle. A 5-year-old plantation raised by him before he gives up his cultivation on it,

* The yield of agricultural crops from well manured farms is usually more than 100 per cent. higher than the yield from unmanured fields.

would soon convince him of the fact that his future fuel supply was secure. The prospect of his being able to use his cowdung as manure, and the consequent increase in his yield, would not fail to enthuse him over his plantations. He will soon be reconciled to the small sacrifice he is called upon to make. As a matter of fact the right of ownership of most agricultural lands is invested in the *samindar*. He could easily set apart all uncultivated lands and if necessary a portion of cultivated lands of a poor type, for fuel and fodder production. He can manage to accommodate his cultivators by so adjusting his lands that the burden is evenly distributed over the whole village. At worst it is only a case of the *samindar* not letting out the whole of his land for cultivation and he is within his rights to do so without causing any serious discontent among his tenants. The State should, however, compensate him for his lost income from the cultivated fields reserved for fuel production for the period till he could enhance his rental on the remaining lands under cultivation, owing to the increase in their yield by virtue of their being well manured. When the transitional stage is over the State can realise its lost revenue from the lands under cultivation which increased yields will amply justify.

11. The scope for afforestation in what are known as culturable waste lands now lying fallow is almost unlimited in these provinces. The problem of the fuel supply of towns should be simultaneously tackled. The sale of cowdung cakes in the towns is mainly governed by the extreme poverty of surrounding villages whose inhabitants sell their valuable manure as fuel for a small consideration of money in ready cash. The United Provinces Forest Department is already handling large areas lying waste near the towns. Most of these lands which bring no revenue to their owners could be easily converted to fine pasture lands for town cattle and fuel reserves. Even *usar* lands which are unsuitable for forest trees can be made to grow fine fodder grass. There is no other way of meeting the demand for grazing grounds. The spectacle of cattle grazing on the provincial road sides can only be remedied if grazing grounds form an important feature of the municipalities. We have already raised many successful

plantations of this description near some of the towns in the United Provinces like Cawnpore, Etawah, Agra, Kalpi and Budaun in fallow lands generally belonging to the *zamindars*. True, these plantations have not been raised by means of *taungya*, but the point to remember is that their proximity to towns renders them a profitable investment.

12. It is difficult to estimate the *bhur*, *usar* and other culturable and unculturable waste lands in these provinces, because they have not been classified as such. The following statement of the distribution of land in these provinces will be found instructive.

Area. (In square miles.)

	FOREST LAND.			Agricultural land.	Other land.	Total.
	Merchant able.	Unprofitable or inaccessible.	Total.			
Under Forest Department ...	3,028	2,186	5,214	...	...	...
Other Forest Areas	2,221	9,877	12,098	...	...	...
Total ...	5,249	12,063	17,312	76,680	12,733	106,725
Per cent ...	5	11.2	16.2	71.8	12	100

The proportion of accessible forests is thus 5% of the area and is obviously very inadequate. Considering that part of the unprofitable forests may yet be accessible for fuel and small timber the proportion would by no means exceed 10 per cent. We have 12,733 square miles of land lying unproductive in these provinces. A very large percentage of this land can be made available for pasture and fuel production.

13. The species to be tried in village plantations should fulfil the following conditions :—

- (a) Easy to propagate.
- (b) Fast growing.
- (c) Coppicing freely.

- (d) Good fuel.
- (e) Yield timber for agricultural implements, if possible.
- (f) Flourish on indifferent soils.

Where these would be grown along with the field crops they would be protected from cattle by the villagers. Susceptibility to browsing need not therefore be considered as a serious impediment.

14. It is difficult to find a single species which will answer to all these conditions. The following species are the nearest approach to the ideal having regard to the conditions of these provinces :—

Species.	Remarks.
1. <i>Albizzias</i> (siris).	
2. <i>Acacia arabica</i> (babul)	... Poor coppicing power.
3. <i>Acacia Catechu</i> (khair)	... Poor coppicing power.
4. <i>Mallotus philippinensis</i> (rohini)	Poor timber.
5. <i>Terminalia tomentosa</i> (asna).	
6. <i>Gmelina arborea</i> (khamar).	
7. <i>Tectona grandis</i> (teak)	... Not suitable to indifferent soils and frost tender.
8. <i>Butea frondosa</i> (dhak)	... Slow growing.
9. <i>Pongamia glabra</i> (kanji).	
10. <i>Dalbergia Sissoo</i> (shisham)	... Poor coppicing power.

15. The fuel requirements of a village with 50 houses where food is cooked for about 300 persons would be roughly 3,000 to 4,000 maunds a year. This is usually supplemented by *arhar* (*Cajanus indicus*) and other agricultural plants which are burnt as fuel after the harvesting has been done. If one acre of land is placed under fuel plantation each year for fifteen years, a sustained yield of fuel and timber for agricultural purposes can be obtained after the last acre has been planted. A few trees (10—15) may be retained per acre for timber production. From the fifth year onwards these plantations will begin to yield some fuel in the shape of thinnings, and the process of replacement of cowdung from household hearths will be complete after 15 years. When the 15-year-old plantation is felled over, it can either be

replanted by means of *taungva* or if the species selected coppices freely the plantation will restock itself. A rotation of forest crop coupled with cattle grazing will enrich the soil considerably and it will pay the cultivator to raise the crops in between the lines of trees. A fast growing species of good coppicing power means quick fuel production and if the rotation of fuel plantation can be decreased to 10 years, only 10 acres need be put under fuel plantations instead of 15 acres. The land in between the lines of trees will be reserved for fodder production after the cultivators have left the area.

16. Quite apart from supplying fuel, fodder and timber for agricultural implements and house building, and releasing valuable manure for ameliorating agricultural lands, such plantations dotted all over the country side will ensure healthy environments, increase the rainfall, act as wind screen against the deadly *loo* during the hot months of May and June, and will relieve the monotony of the Indian plains.

17. It may be emphasized that the scheme mentioned above is by no means perfect and will need modification to suit local conditions in the light of experience gained in the actual working of it. I have merely sought to indicate the lines along which our efforts should be concentrated if agricultural conditions in India are to improve at all. Hitherto, we have merely believed in the policy of *laissez faire* and have allowed things to drift in a vicious circle. The problem is not as difficult of solution as it has been made to appear. I believe it is about time that we made a start in this direction.

KALAGARH FOREST DIVISION.

By F. C. FORD-ROBERTSON, I. F. S.

Kalagarh Division is perhaps the least accessible of the sal divisions of the Western Circle, United Provinces. The railheads of Kotdwara to the west, and Ramnagar to the east both fail to clinch it and alike exact several days march from the intending visitor. Dhampur or Nagina (E. I. Railway) are probably the

best jumping off points, lying south and south-west of the main mass of the division but the former involves an 18 mile march with the Ramganga to cross at the end of it, while between the latter and Morghatti on the divisional border there is 15 miles of rough and almost roadless scrub. But whatever the direction of approach Kalagarh Division presents a hill-girt front defying penetration except at one or two points. The chief of these is provided by the beautiful Ramganga river which in its long journey from central Garhwal finally sweeps south in a mile-wide arc at Buxar, in the centre of the division, and carves a striking course through the last rampart of steeply-dipping sandrock strata before losing all distinction in the monotony of the Gangetic plain. Another gateway, to the extreme east, is the Sultan pass, reached after a stiff climb from the Kosi valley and this is matched on the opposite western boundary by the tortuous cart track, often only fit for camels, that climbs from Koluchaor (in Lansdowne Division) over the sharp-edged col at Laldarwaza. A fourth but less important track winds over the hills between Motal and Morghatti on the Kandi road. None of these, it should be said, is metalled and the grading is capricious.

So much for entrances to a jungle Elysium. All are rendered passable (the word is apt?) for carts after the monsoon—the Ramganga road, which is in places carved out of solid rock often costing a pretty penny in repairs—since these are arterial export routes for the forest wealth within, but motors would receive a sorry shaking, even could they negotiate the three temporary Ramganga bridges. So far as I know, the “internal convulsion engine” (as an eager forester of mine once called it) has not yet desecrated the Kalagarh jungles, though the infection is spreading from the east and its arrival a matter of time.

The division, then, forms a compact, oblong mass covering nearly 400 sq. miles of rugged foothills, and occupying the main drainage area of the Ramganga—including the fine tributary valleys of the Palain and Mandal rivers—between Kalagarh itself at the edge of the plains and Marchula in the north-east, a distance of over 40 miles. Bordered by steep watersheds to east and

west, and by the famous "Kandi" (submontane) road to the south, it casts its northern boundary over the jumbled hills and valleys of the Himalayan hinterland. Except to the extreme north-west, the whole area is Tertiary Siwalik. North of the Ramganga, the hills are micaceous sandstone, south of it friable sandrock alternating with a pale variegated conglomerate, the latter weathering into sheer precipices and knife-edge ridges, in faithful imitation of its larger counterpart fifty miles westward—the Siwaliks of the Dehra Dun. To this rugged and confused terrain the broad elevated valley of the Ramganga—the "Patli Dun"—presents an admirable contrast, alike in form and colour.

Nature has planted the whole submontane tract between the Jumna and Sarda rivers on well-defined lines and a description of the Kalagarh jungles is of wide application. Speaking broadly, the steep southern aspects, hot and dry to a persistent sun, carry mixed deciduous forest of xerophytic type. In this the valuable sal (*Shorea robusta*) is often absent, the chief species being *bakli* (*Anogeissus latifolia*) which is often gregarious, *sandan* (*Ougeinia dalbergioides*) *kusam* (*Schleichera trijuga*), *aonla* (*Phyllanthus Emblica*), *kathbhilawa* (*Buchanania latifolia*), *odal* (*Sterculia villosa*), the scarlet-flowered *dhauldhak* (*Erythrina suberosa*), *jhinghan* (*Lannea grandis*), stunted *Terminalia* species (*T. tomentosa*) *T. belerica*, and *T. Chebula*) and poor *bans* (the bamboo *Dendrocalamus strictus*). The lesser growth is, as might be expected, of the prickly-spiky kind, encounters with such species as *Phoenix humilis*, *bael* (*Aegle Marmelos*) and *kathber* (*Zizyphus xylopyra*) making progress rather a purgatory to the inspecting officer. The stocking is usually open, with much interspersed grasses, including the valuable *baib* (*Ischaemum angustifolium*) while large areas are smothered in vigorous climbers, chiefly *maljhan* (*Bauhinia Vahlia*). This type of forest is left severely alone, having at present little intrinsic value and at the same time being too inaccessible to work and of vital importance, with an 80" annual rainfall, in staying erosion. It forms, however, quite a feast of colour, with the russets and reds of *bakli*, *dhauri* and *kusam*, the delicate jade foliage of *sandan* and the

deeper verdancies of *maljhan*, *haldu* (*Adina cordifolia*) and bamboo.

From this arid, open type of forest to the pure dense sal of the flats and river terraces is a transition at the governance of slope and aspect that forms an object-lesson in simple oecology. Stand on an opposing ridge and you can mark the steady infiltration of the sal on the lower, gentler slopes, can note how every hillside hollow has the betraying olive green patch (turning, as in the great seed year of 1926, to a mist of flowering white in May) and how the sal, finally triumphant and close-stocked, stretches invading arms into the dense savannah of the alluvial flats, with their tall *Saccharum* grasses and glossy, bearded *ulla* or spear grass (*Anthistiria gigantea*) interspersed with the formal-patterned, steel-grey *semal* tree (*Bombax malabaricum*), the flame-flower *dhak* (*Butea frondosa*), *bahera* (*Terminalia belerica*), *siris* (especially *Albizia procera*, perhaps the most beautiful tree in these forests) and a few riverain intruders. In the wide river beds of the Ramganga and the tributary Sonanadi are those masses of pure, regular *sissu* (*Dalbergia Sissoo*) which form such a picture of tender green in February and March. The associated *khair* (*Acacia Catechu*), always a rugged sombre tree even in youth, but an admirable foil to its graceful neighbour, is but poorly represented in Kalagarh Division. Finally, to complete the picture, one must mention the chir pine (*P. longifolia*), the only conifer at these levels, which occupies the highest ridges and is spreading, under the influence of half a century's fire protection, into the deciduous forest below, and, lastly, the restricted but vivid evergreen forest, with its fine *tun* (*Cedrela Toona*), *jaman* (*Eugenia Jambolana*) and many *Ficus* species, filling every moist nala-flat and running far up every hillside ravine that boasts perennial water.

In common with adjacent divisions Kalagarh was subjected to a fearful hacking in pre-Mutiny days, and it is due to the famous Colonel Ramsay (then Major) that these tracts were cleared of squatters and cattle stations, and put under a definite conservancy scheme. The momentous Act of Reservation (1879) followed, and thereafter is a long tale of careful conservation

and improvement, of fire protection and road making and building that has its counterpart, as a record of solid if unobtrusive achievement, in more than one Province. Details of the various Working Plans—there have now been five—are only of local technical interest, but the year 1914 is noteworthy a commencing the application, both in this and other submontane divisions, of the Uniform System to the by then recovered valuable sal crops, with a conversion rotation of 120 years. The vicissitudes attending this important step have received sufficient notice in this journal to render any account here superfluous. The mixed hill forests—by far the greater part of the division—with which are included both the chir and the limited evergreen crops, still continue under selection and improvement fellings, sal and *sain* (*Terminalia tomentosa*) being considered exploitable at 16" or 20" diameter, according as the locality is below or above III quality class. The riverain *sissu* has a selection circle of its own, all 16" trees being considered mature, while the bamboos are worked in 4 coupes (in cutting series) which necessarily overlap the Hill Selection Circle.

All sales now-a-days are on lump sum and the wide plain, market embraces Delhi and Meerut. Sal, of course, is the great revenue producer, between 2 and 3 lakhs of cubic feet leaving the division every year, much of it in the form of sleepers of every size, the best of which are passed and despatched by the Department to different contracting Railways. There are also *kolhus* (logs free from sapwood), *joras* for cart shafts, scantlings, and *ballis* or barked poles besides such smaller fry as *pattis* and *sirwas*, which make the bed-frame of the native *charpoy*. Large beams are rarely exported owing to the rough and poorly graded roads. *Sain*, *haldu* and a few other species are finding an extended market or regaining old ones, but a lead of 40 miles as in the Mandal valley, practically kills the demand. The lowly *sandan*, however, finds a perennial sale, supporting a myriad cultivators alike in work and repose—its use for cart-axles and *charpoy* legs being as old, one supposes, as ancient Ayodhya. The *sissu* by virtue both of intrinsic merit and natural accessibility, commands a ready, if fluctuating, sale, the best of it for

furniture and much for cart wheels, but the evergreen *tun* with a rosier, lighter wood, is held in less esteem, and magnificent specimens still grace the Palain and Mandal valleys. Fuel, as might be guessed, is saleable only along the south border, all interior coupes being resigned to a heavy litter after working—a wasteful burden which even the right-holding villagers on the northern boundary can do little to relieve. It is the custom of the bigger contractors to skim their lots for the cream of the timber and wherever possible a re-sale is made in the following year to smaller men. Their thoroughness in working varies extraordinarily.

Extraction was once monopolised by the *jhojas*, Moham-medan plainsmen who have specialised for generations in dragging timber by buffaloes and bullocks. This arrangement, if economical in manpower (for one man can manage a score of animals) is ruinous alike to the roads and to the timber and remains only as a necessary evil. For the present the divisional revenue still depends largely on their services but carts are being attracted in ever increasing numbers by the policy of improving the roads and confining the *jhojas* to specially made dragging paths. Camels are also in general use for carrying the shorter material. Metre-gauge sleepers, six a side, form a favourite load.

Revenue from bamboos, always very variable, has dwindled of late years. In an annual coupe extending to 80 sq. miles of difficult country, the problem of supervision—more especially the prevention of high cutting and the attendant deterioration of the clumps—is a recurring one: while, in the last decade, seeding has been heavy. The Ramganga is, of course, used for rafting, although *jhojas* also take some export, and rafts may go the whole 60 miles to Moradabad before being broken up.

The valuable *baib* grass areas are reserved for a Calcutta firm on long term contract. Their chain presses go up in all the outer Kandi *sots* early in November and a stream of 2 maund bales leaves the division for Ramnagar and Nagina right up till June, both camels and carts being used. Other

minor produce is of little value or interest, but the Sonanadi river yields small quantities of gold, the right of panning which is leased out for a small sum. Geologists discourage any idea of an El Dorado.

The population of the division, it will have been gathered, is sparse. Actually, within the division itself it is non-existent, although an ancient and, I believe, unidentified settlement has lent its curiously carved and often massive stones to more than one forest bungalow and *chauki* along the Ramganga. Anyhow, the old time cultivators of the Patli Dun must, one imagines, have been grateful to Colonel Ramsay for his essay in human transplantation, and have found the Bhabar country a far kinder home than the barren boulder-strewn flats round the Ramganga. Wild game apart (and this must have taken a heavy toll of stock and crops) the Dun valley is no sanatorium. In the winter months the cold hill air, restricted by the bottle-neck of the Ramganga pass, collects as a dense and freezing fog, which may not disperse until late in the forenoon. The shade temperature then rushes up 50 degrees or so, providing an uncomfortable contrast. Nature is no less affected than man, frosting being chronic and often severe over a wide area, and the economic loss through retarded growth and damaged timber must be very considerable. The locality is rather malarial—in the rains, of course, extremely so—and the forest staff, even in their recess quarters, suffer considerably. The first monsoon burst sweeps away the temporary bridges and blocks the roads, completely shutting off the Dun from the plains and markets. The early cultivators must have been a hardy lot.

The population, in short, is essentially a migratory one, the *pattis* of both hill and plain contributing to the labour supply, just as soon as their *rabi* crops are sown. The best sawyers are Delhi men, paid a special rate, but the other forest workers are a medley. To the cattle stations come certain hill people (*gothias*) with judiciously restricted herds, while small shops are sanctioned at strategic points to down-country traders, thus assuring essential supplies to the forest population. A *painth* or

weekly bazaar is held at Kalagarh itself but that is strictly an extra. This November influx is astonishingly rapid and the jungle is soon humming with activity. Late March sees the first signs of exodus, so important structural work has to be started early, skilled workers being the first to leave for their homes.

The division has twenty comfortable bungalows and actually needs more. *Shikaries* are coming in ever increasing numbers, but find it difficult to cover the three northern ranges. The shooting is very fine, and in the hot weather especially, the place crawls with tiger, attracted to the cool *narkhal* swamps of the Dun and the shady "lie-ups" round Barsoti and Bilot. It is recorded that one D. F. O. put up five tigers in the famous Nimbu boji for a distinguished visitor, but lest this cause a rush to the place one must add that the best "beats" require elephants on a gubernatorial scale. It is perhaps on this account that the tiger-slayer is more successful in the tributary Sonanadi valley. The division is in places overrun with *chital*, but heavy heads are very few. There are good *gond* (swamp deer) in the north Patli Dun, also *sambhar* and a few *para*, while the little red *kakar* (barking deer) is extraordinarily common throughout the hills, as are *gurrel* (Himalayan chamois) on precipitous ground. There are also a lot of bear (sloth) but panther are comparatively few, possibly because of the great number of tigers. Some elephants, as shy as they are destructive, haunt the outer hill valleys but rarely trouble men. Perhaps the commonest bird is the *kalij* (pheasant) but jungle fowl, partridge, quail, etc., are well represented and some of the Kandi *sots* abound in peafowl.

The fishing is excellent, in spite of otter, crocodile and enormous *goonch*, the mahseer running to forty pounds at least in the lower reaches of the Ramganga. The Palain, also full of fish, is persistently poached from the adjacent hill *pattis*.

At some not too distant date, the writer hopes, the south Patli Dun will be constituted a game sanctuary, for which it is admirably designed and endowed by Nature.

LINEAR SAMPLE PLOTS.

BY E. O. SHEBBEARE, I.F.S.

I do not know whether the idea of making sample-plots in the form of valuation-survey lines is a new one. During the past seven years we have been using such lines in Northern Bengal in the hope of finding out something of the growth and composition of our plains forests which consist of a mixture of over 250 species.

The procedure is to cut narrow paths on a compass bearing through different parts of the forest and to measure and determine the species of every tree over six inches in diameter for half a chain on either side. So far this is the ordinary valuation line, but we are going farther and maintaining each line as a sample-plot, painting the usual crosses, numbering the trees with zinc labels, and remeasuring after two years and subsequently every five years.

We have something over twenty miles of such lines at present. The cost is small but, as the work takes up some of the time of the Silvicultural Division, it seems worth while to be quite clear as to what results we are getting or hope to get and to consider the best use to which the work can be put. It is with this object that I am writing.

It is clear that such lines can not be used for most of the ordinary purposes of a sample-plot (because, for one thing, the timber volume cannot be determined with any accuracy) but, on the other hand, it seems likely that they will give useful information in other directions.

The investigation was started to find out :—

1. The quantities of each species in the present crop.
2. The rates of growth of all species and the sizes they attain.
3. The most profitable species to grow in various localities.
4. The best classification of localities into types.
5. A means of identifying these types by trees, undergrowth or soil.

1, 4 and 5 could, theoretically, be answered by ordinary valuation lines but, in practice, permanent numbering makes the identification of unknown species possible.

The lines are giving us a thorough survey of tree-species and several which had not been recorded from our area before have been found by this means. The finding of a species new to a locality often means that it becomes recognizable to one man who may or may not pass on his knowledge, but a Linear Sample Plot becomes a living herbarium where anyone can learn to recognize the tree in the forest. This purely botanical use of the lines was no part of their original object and certainly does not justify the name Linear Sample Plots.

So far the only practical result has been to bring to notice certain species likely to be suitable for plantations, especially for moist sites. There is, however, no doubt that those of us who have studied these lines have gained a good deal of knowledge of trees and of general conditions prevailing in our plains forests which we did not possess before. This is bound to be useful if it can be recorded and made available, but here we are up against the real problem. What should be our "aims and methods" in studying these so-called Linear Sample Plots? We should be very grateful indeed for any advice or suggestions.

**NOTE ON BOGA MEDELOA (TEPHROSIA CANDIDA) AS
GROWN AT SUKNA, KURSEONG DIVISION, BENGAL.**

BY T. M. COFFEY, I.F.S.

*Boga medeloa was grown without field crops in the first year
immediately after clearing and burning the coupe.*

1. *Collection of seed.*—Collect the pods as they ripen (*i.e.* when they begin to turn black) usually about February ; sun daily until thoroughly dried and beginning to crack ; then beat with a stick to separate the seeds ; or, if a large quantity is to be harvested, drive cattle over the pods to do the threshing.

The usual cost of collection is Re. 0-1-0 to Re. 0-2-0 a seer of cleaned seed. It is cheaper to collect the twigs with the pods on them, but in that case, as some green pods may also get

collected, there will be a smaller outturn per acre and less germination per cent. Therefore collect with twigs if short of labour, and pod by pod if short of seed, going over the area two or three times as the pods ripen.

Rs. a. p.

NOTE :—Range Officer, Sukna (Babu R.

L. Acharya, E.A.C. Forests) collected

264 tea-leaf plucking baskets of un

cleaned seed @ Re. 0-3-0 a basket ... 49 8 0

Cost of cleaning same ... 7 15 0

Total ... 57 7 0

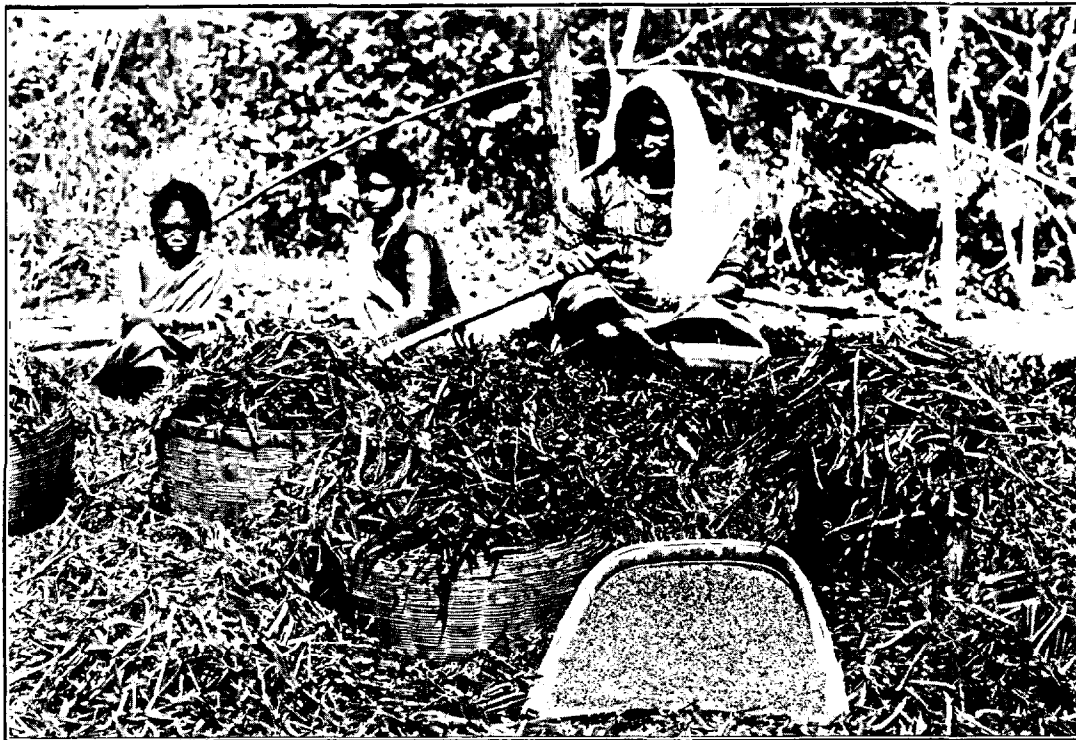
The outturn was 18 mds. (*i.e.*, $2\frac{3}{4}$ seers per basket) which works out at Re. 0-1-3 a seer).

2. *Preparation of the soil*.—After cleaning and burning, a shallow hoeing (4" deep) of lines 1' wide midway between the lines of the forest crop is recommended. This is usually done at about Re. 0-13-0 an acre.

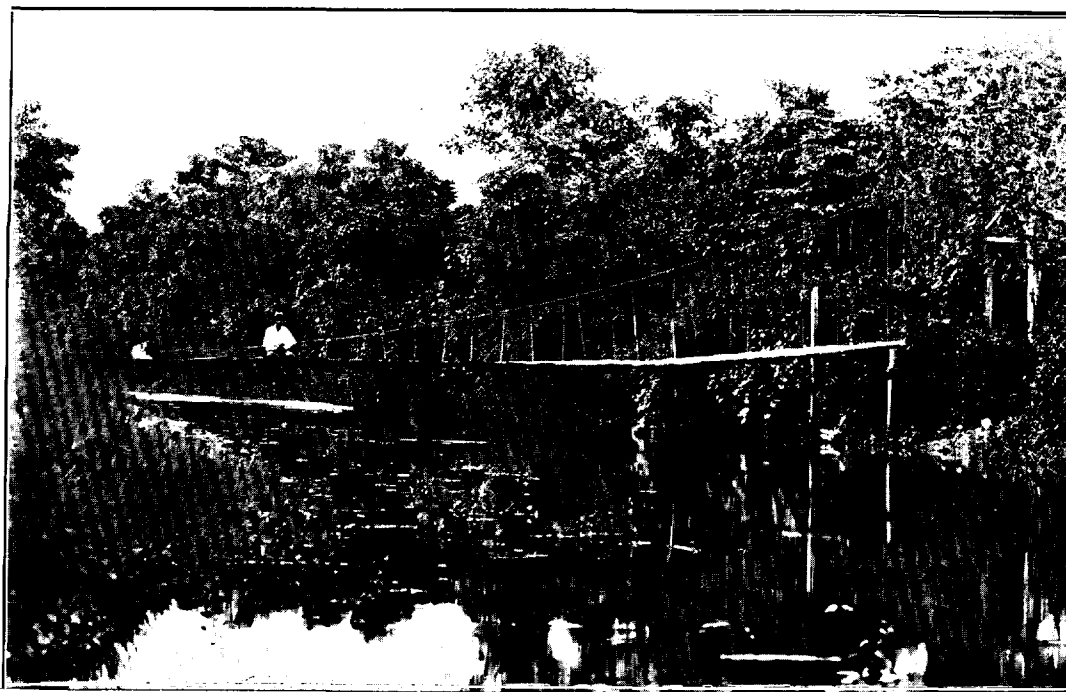
3. *Sowing*.—Sow direct at least 10 seers per acre just like mustard and cress at the end of April in the 1' wide hoed lines. In the case of *gurjan* (*Dipterocarpus* spp.) sow a little also actually in the *gurjan* lines to shelter the *gurjan* in the hot weather. A forest guard can do the sowing. Cover the seed with a layer of fine earth not thicker than the diameter of the seed.

4. *Tending*.—One weeding is usually required just when the rains break, but timely sowing saves weeding and makes certain of good germination.

5. *Pruning*.—*Boga* must be pruned (with the exception of *boga* grown with *Dipterocarpus* spp. about which we are not quite certain). The first year's pruning is done 6" from the ground, the second 6" above the first cut and so on. Pruning should be done with a very sharp knife, because, if the stem splits or breaks, it will not coppice well. Prune immediately after collection of seed and only once a year. Should the



Boga medeloa (*Tephrosia candida*) pods strewn on the ground before threshing.
 Note boga seed in bamboo tray ready for winnowing.
Sukna Range, Kurseong Division, Bengal.
(Photo taken February 1929).



Suspension bridge over the Panchanai River, near Sukna Forest Bungalow in Kurseong Division,
 constructed by the Students of the Bengal Forest School, in 1927.

Boga medeloa overtop the plants during the rains sickling the side branches can be done. About three prunings will be required in slow growing plantations and two in others ; after that the *boga* gets covered over and stops growing but it is left until killed out by the plantation.

Early pruning favours coppicing.

6. Financial statement (per acre) :—

Sowing.	Expenditure.	Revenue.
	Rs. a. p.	Rs. a. p.
Cost of seed 10 seers @ Rs. 20 per maund	5 0 0	
Hoeing per acre	0 12 0	
Sowing per acre	0 4 0	
Weeding @ Re. 0-0-6 per <i>luggi</i> ...	1 10 0	
<i>Harvesting—</i>		
Collecting 1 maund 10 seers @ Re. 0-1-6	4 11 0	
Packing, weighing, carting and despatching	0 2 0	
Average outturn per acre 1 maund 10 seers @ Rs. 20 per maund ...	...	25 0 0
Total .	12 7 0	25 0 0

Net profit = Rs. 12-9-0 per acre.

FENCING PLANTATIONS IN NORTHERN BENGAL.

By T. M. COFFEY, I.F.S.

The following note gives the details of cost :—

	Rs.	a.	p.
1. (a) Cutting and barking sal posts 10' long (7' above ground and 3' below)—each	0	1	0
(b) Carrying posts to fencing—each ...	0	0	6
(c) Fixing posts to fencing—each ...	0	2	0

	Rs.	a.	p.
2. Fixing and straining wire (this includes wove and barbed, but does not include dismantling old wire) per $\frac{1}{2}$ r. ft. ...	1	0	0
(2 rows barbed wire at 12" and 18" respectively above wove wire. Bury wove wire 6" in ground and facing outwards, for pig).			
3. Gates, self-closing and 5 barred, one only, 10' \times 4 $\frac{1}{2}$ ' ; labour for making, each ...	8	0	0
(2 rows barbed wire at 1' apart above top bar, and wove wire across the gate).			
4. Styles (use sal bakals) labour only, each ...	2	0	0
NOTE :—For a plantation 350 yds \times 560 yds (40 acres) all the above amounted to Rs. 160 <i>i.e.</i> Rs. 4 an acre for labour for all four sides. This Rs. 4 may be considered a maximum, as plantations are always contiguous and, therefore, it is never necessary to fence more than three sides at the most.			
5. Frost Ringlock wove wire, 9 $\frac{1}{4}$ gauge, type No. 3, 9 bars, 48" high, 1,820 yds. (for 40 acres) or 8.3 rolls—per roll ...	73	0	0
Railway freight on 8.3 rolls wove wire	51	14	0
6. Barbed wire, 2 ply, 4-points, clusters, 3" 4" apart. 3,640 yds. (for 40 acres) or 6.9 rolls (cwts.)—per roll ...	12	14	0
Railway freight on 6.9 rolls barbed wire	8	11	0
7. Staples 1 $\frac{1}{2}$ " (1,000 = 14 lbs.) 57 lbs. (for 40 acres)—per lb. ...	0	2	0
Railway freight on 57 lbs. staples ...	0	8	0

The above gives a proportion of 1,820 yds. wove wire to 3,640 yards barbed wire to 57 lbs. staples, or 8·3 rolls to 6·9 rolls (or cwts.) to 57 lbs. For a plantation 350 yds. × 560 yds. (40 acres) this (*i.e.*, items 5 to 7) amounts to Rs. 19 an acre for materials for all four sides; but, assuming the wire and staples will stand two turns *i.e.* see two different sal plantations through until their first thinning and current prices remain in force, the cost per acre comes to Rs. 9-8-0. This Rs. 9-8-0 may be considered a maximum as plantations are always contiguous and it is, therefore, never necessary to fence more than three sides at the most.

Taking all items, *i.e.* 1 to 7, the cost comes to Rs. 13-8-0 an acre for four sides or about Rs. 10 for three sides.

KANA STUBBING IN THE POPLAR (POPULUS EUPHRATICA,) FORESTS OF MULTAN DIVISION, PUNJAB.

BY RAM NATH KASHYAP, P.F.S., D.F.O., MULTAN.

These poplar forests were described by the writer in the *Indian Forester* for 1923. Since then the knowledge acquired has been embodied in the first Working Plan for these forests published in 1927.

2. A detailed description of the composition and condition of the crop will, therefore, not be attempted here. It will be sufficient to say now that with the exception of the low lying localities which are annually flooded from the Indus, and where the crop is canopied, and consequently free from *kana* (*Saccharum Munja*) grass, these forests are a mass of young poplar standing in a dense growth of *kana*. This condition presents two grave difficulties, *viz.*, danger from fire and the certainty of the young saplings being choked by the dense growth of *kana* grass.

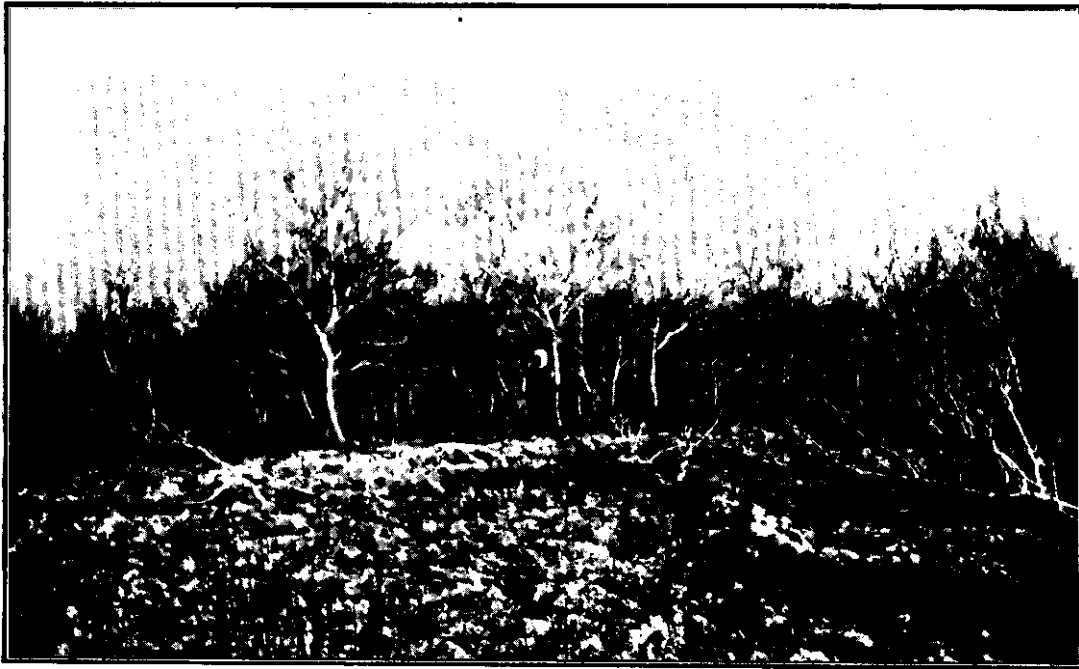
3. The danger from fires has been greatly minimised by making a network of 30 to 50 feet wide firelines, which divide the forests into small compartments varying from 24 to 185 acres in size. This method of fire protection has been very successful, but from his long and continued observation of eight years the writer is very doubtful of the utility of this measure. The fires

have been observed to stimulate the growth of root suckers of poplar rather than have any adverse effect. The fresh crop of root suckers that comes up after the fire, grows very well during the first 2 or 3 years, and then begins to dwindle down and die from suffocation caused by the *kana* grass which becomes thick and dense again in that period.

4. Although fires have been observed to be useful but they are by no means a remedy for eradicating this weed. Stubbing out of *kana* has been tried and has been found very successful even in dry localities. The accompanying photographs illustrate beautifully the difference made in the growth of the crop by the removal of *kana*. They represent crops of the same age and standing in exactly similar conditions, except that areas in photo 1 (plate No. 26) have been kept clear of the grass while that in photo 2 has not been touched. They all have been fire-protected since 1919. The difference is apparent.

5. These particular *kana* stubbed crops form two compartments of Ranuja forest, 51 and 60 acres in extent, and the cost of first stubbing and subsequent keeping out of *kana* grass is given in the following statement:—

Year	Cost of <i>kana</i> stubbing.					
	Compartment 11 = 51 acres.			Compartment 12 = 60 acres.		
	Rs.	a.	p.	Rs.	a.	p.
1921-22 ...	396	6	0	...		
1922-23 ...	58	11	0	320	2	0
1923-24 ...	45	0	0	50	0	0
1924-25 ...	7	10	0	8	0	0
1925-26 ...	7	0	0	7	2	0
1926-27 ...	7	0	0	8	0	0
1927-28 ...	4	0	0	4	12	0
1928-29 ...	4	8	0	5	0	0
Total ...	530	3	0	403	0	0



Poplar crop about 10 years old, kept clear of kana grass since 1921-22 ; in height 2 to 3 times that of the man.



Poplar crop about 10 years old, kana grass not removed ; crop not higher than the man, kana generally tops the crop, protected from fire since 1919.

	Rs.	a.	p.
Total cost on keeping out <i>kana</i> grass from 51 + 60 = 111 acres in 8 years has amounted to	933	3	0
or Rs. 8-6-6 per acre.			
Add cost of keeping out <i>kana</i> for another 17 years @ Re. 0-1-0 per acre per annum	1	1	0
Total cost of keeping out <i>kana</i> grass during the period of 25 years, after which the crop will be ready for coppice fellings comes to Rs. 9-7-6 or say	10	0	0

The area thus kept clear of *kana* grass, will yield at least 2,000 c.ft. stacked of firewood per acre when coppice felled and this wood will be worth Rs. 120 at the present market rate. So the expenditure incurred on *kana* stubbing cannot be grudged.

6. Since 1922-23, on an average, 300 acres are cleared of *kana* grass annually and so far 2,111 acres have been treated. On initial stubbing and subsequent removal of *kana* an amount of Rs. 11,235 has been spent, which is equivalent to 5 rupees per acre. Even on dry shallow soil with pure sand below, the removal of *kana* grass has shown considerable improvement in the growth of the crop. If this war against this coarse grass is continued, there is no doubt that these long neglected poplar forests will become a valuable public estate.

EDITORIAL.

THE BRANDIS PRIZE FUND.

We would remind the Members of the Board of Management of the *Indian Forester* to inform all past and present

REVIEWS.

AUSTRALIAN RAIN FOREST TREES.

BY W. D. FRANCIS,

Assistant Botanist, Department of Agriculture and Stock, Brisbane.
(Obtainable from the Council for Scientific and Industrial Research, East Melbourne. Price 10 shillings plus postage—5d. per copy).

This volume is one of the best of the kind we have seen produced in the Dominions. It is not quite so good as "Malayan Forest Records," No. 6 "Mangrove Forests of the Malay Peninsula," but that is quite an exceptional volume for a forest publication and compares favourably with most of the Forest Records and Bulletins issued in India. The Australian book does not come up to the level of the Malayan volume in the illustrations, paper and binding, but it is very good of its kind and will be of the greatest interest to foresters of all countries.

The author has spent many years botanising in New South Wales and Queensland, and lived for about ten years in one of the richest rain forest belts of sub-tropical Australia. The descriptions are all original, and the sequence of families is that of Engler and Prantl!

The very numerous photographs, over 200 altogether, were taken by the official photographers of the Department of Agriculture and Stock, and by the author, the latter being responsible for the photos of the trees in the forest, and the former providing the pictures of the leaves, flowers, and fruits.

Indian forest officers will be interested to see that the following genera often occur in the rain forests north of 29° S:—*Tarrietia*, *Dysoxylum*, *Cedrela*, *Elaeocarpus*, *Ficus*, *Eugenia*, *Litsaea* and *Cinnamomum*, and they will thoroughly appreciate the remark "In most cases the species constitution is very complex and often variable within short distances."

A North Queensland *kauri* (probably *Agathis Palmerstoni*) has been measured 29 feet in girth and *Araucaria Cunninghamii* (the Hoop Pine) may attain a height of 180 feet.

Buttresses are an important feature of the large trees especially in the case of *Ficus*, *Dysoxylum*, *Cedrela*, *Elaeocarpus* and *Eugenia*.

A useful key or artificial sub-division to facilitate identification is given and all the important trees are illustrated by excellent photographs.

We congratulate the Government of the Commonwealth on this publication.

TANNING MATERIALS OF THE BRITISH EMPIRE.

(REPRINTED FROM THE BULLETIN OF THE IMPERIAL
INSTITUTE, PP. 100.)

London, John Murray, 1929.

The original of the present monograph was prepared in the form of a series of four articles published in the *Imperial Institute Bulletin* during 1927-28, giving a general account of the investigations on important tanning materials carried out in the Institute during the past 25 years. The importance of the tanning materials in the Empire was realised during the war, when it was found that the United Kingdom depended for more

than half her consumption of tanning materials on foreign supply. On the reorganisation of the Institute in 1926, special attention was devoted to this subject, with a view to exploring new sources for these materials.

The monograph deals with barks, woods, leaves, fruits, tubers and a few miscellaneous tanning materials, including not only those in established use but also those that are worthy of consideration as new materials of commerce. Of particular interest to India are the following :—

Wattle bark (*Acacia mollissima* and *A. dealbata*) of which India imported 176,615 cwt. from South Africa.

Mangrove bark (*Rhizophora conjugata*, *R. mucronata*) of which large supplies, it is said, are available for commercial exploitation in the British Empire. There appears to be growing market for this, as mangrove is calculated to be the cheapest tanning material per unit of tannin.

Avaram bark (*Cassia auriculata*). The success of the tanning industry in Madras is apparently almost entirely due to the peculiar qualities of this bark.

Babul bark (*Acacia arabica*) is the most important tanning material of Northern India, though its importance as a tanning material is not very great outside India.

Oak bark (*Quercus incana*). This is not being utilised to any great extent as the cost of transporting the bark from the hill forests renders it difficult to create a profitable industry.

Chestnut (*Castanopsis tribuloides* and *C. argyrophylla*). Experiments carried out in Dehra Dun show that these trees give an extract richer in tannin than any similar European trees, but the production of such extract in Burma has not been proved as a commercial possibility. If a product of good quality can be made, a ready market would be found in the United Kingdom.

Cutch from *Acacia Catechu*—Burma is the chief country producing cutch. 25 years ago it had a large trade in this material,

but of recent years this trade has declined owing to cutch having been replaced in industry by cheaper materials. In 1925-26, 59,827 cwt. of cutch and gambier leaves valued at Rs. 15,82,652 were exported from India.

Myrobalans—This finds an extended application as a tanning material in Europe. The commercial value of myrobalans is, however, not governed altogether by the percentage of tannin they contain but depends on various qualities. It is one of the chief 'bloom' yielding tanning materials and is especially useful in the production of sole leather. Total exports of myrobalans from India in 1927-28 was 1,927,487 cwt. valued at Rs. 12,203,697.

Under the miscellaneous tanning materials the following are dealt with :—

Anogeissus latifolia (dhawa), *Carissa spinarum* (karunda) *Cassia Fistula* (amaltas), *Hopea parviflora* (Ironwood), *Phyllanthus Emblica* (aonla), *Pinus longifolia* (chir), *Pinus Khasya*, *Shorea robusta* (sal), *Terminalia Arjuna* (kahua).

The Imperial Advisory Committee on Tanning Materials considered that publication in the present form would be useful, and consequently the articles have been revised, brought up to date, and illustrated with graphs showing variation in the prices of the chief tanning materials.

EMPIRE FORESTRY JOURNAL—VOLUME 8, No. 2, 1929.

The journal opens with the usual editorial notes and miscellanea, covering such items as the publication of an *Empire Forestry Hand-book*, the issue of which will be awaited with interest; the decision to adopt a badge and the motto "Prospice, perspicere," for the Empire Forestry Association.

The main part of Volume 8, No. 2, except for short reviews of nineteen recent publications, comprises seven papers, the majority of which deal with the economic side of forestry. The longest paper is by C. R. Robins on "Air Survey and

Forestry," which gives an excellent and concise account of recent development in the use of aeroplanes, both for topographical survey and stock-mapping with and without photography. The paper covers 28 pages and is well illustrated with good photos and specimen maps. It would have improved matters if the photo opposite page 225 had been printed the same way up as the map on page 226 made from it. Brief description of photographic methods and sketching are given together with examples of details of work, costs, etc., from actual surveys made in such widely distributed areas as Burma, Canada, England, Egypt, and Northern Rhodesia—a most useful and interesting paper.

The second article by H. R. Blanford on the "Output and export of Hardwoods (exclusive of teak, which has its own assured market) from Burma" sounds a note of warning to those who think that the tropical forests of the Empire contain vast unexploited stores of hardwoods available for world trade only awaiting development. The conclusion arrived at is that for many years to come the export of the timber other than teak will be confined to valuable furniture woods, for which the demand will be limited, and for sleepers for Indian Railways, so long as the increasing local demand for timber does not force the price of Burma sleepers to a point at which they can no longer be utilized economically.

The article by D. B. Arnot on "Timber Extraction in Johore" is an interesting account of methods where the buffalo and the tractor cannot compete with man-hauling. The method adopted with cheap Chinese labour using sled-ways is described and illustrated with three excellent photographs, which give a very good idea of the methods adopted.

In "Lumbering in British Columbia" by James Kay we have an account of methods far removed from the somewhat primitive sled-ways of Malaya. The article deals with extraction by skidders and tramways using geared locomotives and contains an account of the usual type of mill-lay-out and typical machinery used in concentrated lumbering.

A paper by H. A. Read on "Mining Timber read at the meeting of the British and South African Associations for the advancement of Science in August last year, traces the history of the utilization of timber for props since the discovery of the gold mines in 1886. During the last twenty-five years the consumption of timber for props has increased thirteen fold and as long ago as 1894 an extensive plantation of eucalypts had been established to the north of Johannesburg with a view to partially meeting the ever increasing demand for mining timber. Recent developments have been in the direction of using smaller sized timber with Cribs of special design and to-day probably 80 to 90 per cent. of the prop timber does not exceed 6" in diameter. In spite of the increased use of wire and concrete, it is evident that there will always be a large demand for locally produced timber and the author estimates the present consumption at over $3\frac{1}{2}$ lakhs of tons.

G. A. Wilmot's article on "Timbers suitable for match making" is another paper read at the same meeting. He briefly summarises the mechanical and physical properties which constitute suitability for match woods and enumerates the common species used in the industry. One rather feels that the estimate of the number of matches consumed in the world annually is exaggerated—perhaps the tobacco was damp.

The last paper is an œcological study by A. C. Forbes Director of Forestry, Irish Free State, on the "Button Grass Plains", which cover extensive areas in the west and north-west of the island. The author points out the danger of judging the possibility of reclaiming and afforesting areas of the type by the results obtained under agricultural conditions, where extensive manuring is economically possible and emphasises the part played by mechanical operations such as drainage, which are usually not economically sound on account of expense, in the reclamation of swampy areas.

C. E. S.

EXTRACTS.

FORESTRY IN THE MALAY PENINSULA.

BY B. H. F. BARNARD.

Malayan Forest Service (retired).

The Federated Malay States may be accounted fortunate in that the importance of their forests was recognized, at least partially, before the full flood of land development had set in and before any serious damage had been done. How much happier would the histories of many other colonies be if the realization of the value of their forests had not come to them only after the forests had been destroyed.

On the islands of Singapore and Penang some steps had been taken in the early days of settlement to preserve the forests on the higher hills, and as at that time no one wanted the forests or the land on which they grew, there was, for a long time, no difficulty in achieving the object aimed at. Later on, however, as the population increased, the demand for both wood and land increased, and as there was no organized authority specially responsible for the protection of the forests, it naturally followed that inroads were made on them until towards the end of the last century, when the Local Government demarcated forests for permanent reservations and stayed the hand of the destroyer.

In the case of Penang the stand was not made in time to save the forest cover on the lower slopes of the hills. Here the hills are so near the sea that no damage has been caused by erosion or flood, but the beauty of the island is now marred by large bare areas on the lower parts of the hills which are particularly apparent when approaching Penang by sea, as all must do.

Development on the mainland began much later. That part of the Peninsula which is known as the Federated Malay States, may be said to have started its history, as far as the white man is concerned, in the year 1874, when under the Treaty of Pangkor the Sultan of Perak offered to receive a British Resident and to accept his advice in all questions of administration except those touching religious matters. In succession, the States of Selangor, Negri Sembilan and Pahang also accepted the service of British advisers and development was rapid, particularly on the western coast of the peninsula.

Tin mining had been carried on in a small way and without security, by Chinese from time immemorial, and with the advent of settled government, mining increased greatly, but as regards area, it touched only a very small part of the country and the forest still reigned supreme.

The opening up of the country by railways and roads entailed a destruction of much of the forests in their vicinity, and within a few miles

of the small towns and villages that sprung up near them, but in 1896 probably 95 per cent. of the whole country was virgin forest.

It was in 1896 that the first steps were taken by the Government to establish a special service charged with the protection and management of all State Forests. In those days trained forest officers were unknown in the Tropics outside India, and had one been available, it is probable that it would have been considered that local knowledge was of more importance than scientific training in forestry, and such a decision would have been right, provided that the man chosen understood the general objects and principles of forestry. The first forest officer appointed was Arthur Bligh Stevens, who had for some years been engaged in tobacco growing in Sumatra and later in sugar planting in Perak. He was sent to India to study Indian methods at Dehra Dun, and to see what he could of those methods as applied in the provinces. On returning to Perak his first efforts were directed to the constitution of permanently reserved forests and to the systematic collection of revenue on timbers, firewood and other produce removed from state forests.

Before anything could be done it was necessary to get legislation passed which would ensure that reservation should give the Government an incontestable title to the forests when reserved and could also provide appropriate penalties for encroachment and illegal removal of forest produce. Simple laws were enacted to attain this object, subsequently revised, and the present forest laws are based on those in force in India.

It is the reservation of forests with which we are particularly concerned in this paper. The main objects of forest reservation at that time was considered to be the conservation of the timber and firewood supplies of the community. It was but then fully realised how urgently necessary it was to maintain the forest cover, particularly on the mountain ranges, in order to prevent the run off of rain causing erosion of the hill sides by torrents and the consequent silting of rivers and flooding of the plains. The importance of this protective value has since been proved, and the disastrous results of removing the forest without providing other adequate control of the surface water, have been so obvious that even the most sceptical critics of the forestry movement have been silenced.

In 1898 the writer was appointed assistant to Stevens in Perak, and in 1900 sent to start the good work in the State of Selangor. Shortly afterwards forest officers were appointed to the State of Negri Sembilan and Pahang. For some years there was no difficulty in obtaining the consent of the Government to reservation, for the forests were so vast and the demand for land for other purposes so small. The administrative officers in charge of districts did raise objections to the reservation of forests situated on or near roads on the ground that the land was required for other purposes such as mining or planting. Within limits this objection was reasonable, but in many cases it was carried too far with the result that in certain districts where the development of industry and

increase in population has been greatest, the sources of supplies of timber and fuel are now inconveniently far from the centres of consumption. On the whole, however, the policy of reservation has been successful. It is not yet complete in all States, but by the end of 1928, 275,517 acres or 21.1 per cent. of the total area of the four States had been permanently reserved and a further million acres were in process of reservation. Alienated land accounts of 15.3 per cent. and the remaining 63.6 per cent., including the million acres referred to above, is still unappropriated for any particular purpose. Both reservation and alienation are still in progress and the demand for mining and agriculture are often in conflict with the recommendation of the Forest Department. It should be borne in mind that of the existing forest reserves a very large proportion consists of steep mountain ranges which are generally unsuitable for agriculture and are at present for practical purposes inaccessible, and the same may be said of the unappropriated land.

At the beginning of the twentieth century the cultivation of Para rubber (*Hevea brasiliensis*) began to attract attention. The first plants, twenty-two in number only, were introduced in 1877. From the seeds of these trees experimental plantations were raised by the Government, and from these seed was later distributed to the public. The subsequent history of the development of the rubber plantations is an amazing story, but it cannot be told here. It is sufficient to say that at present the area under rubber in the Federated States is about 1,250,000 acres. The rush for land for this purpose in the first decade of the present century was enormous, and it was fortunate for the country that large areas of accessible land were already reserved. There was, of course, some hostility to reservation by those who entered the scramble for land too late and had not the reserves already been in existence, it would have been difficult for the Government to have resisted the incessant clamour for land. Even as it was, the destruction of valuable timber was prodigious. Before rubber can be planted the forest must be felled and burned. The volume of commercial timber, exclusive of inferior timber and firewood, may be taken on an average as being forty tons per acre. Some of the timber had been removed from a comparatively small area of the destroyed forest, and a little was saved after the burning, but allowing for this and for the fact that on some of the alienated land, the forest had not yet been felled, it is probable that not less than thirty million tons of timber was destroyed.

Much of this waste was inevitable in the circumstances. There would have been no justification for hoarding up the development of agriculture until all the timber had been removed, an operation that must have taken a very long time indeed. During the last ten years or so, alienation of good forest land for agricultural purposes has been delayed until the best timber has been removed.

The forest is of the type generally known as mixed tropical rain forest and is composed of a multitude of broad leaved species. There is a larger

number of tree species in the Malay Peninsula than in the whole of India and Burma. The forest is everywhere very dense, and it is impossible to move about in it without cutting one's way unless following a track previously made--and these are few and far between. The average height of forest of good quality is about 150 feet, the tallest record height measurement that can be guaranteed being 265 feet. This was a tree of the *Dyera* species, of the order Apocynaceae, which not infrequently exceeds 200 feet.

As regards the kinds of trees of which the forest is made up, the *Dipterocarpaceae* are the most numerous and the most valuable. Valuation surveys indicate that in good forests about sixty per cent. of the total volume of timber is produced by trees belonging to this order of the hardwoods, that are known locally as *chengal* or *benak* (*Balanocarpus Heimii* King) is generally considered the best for heavy structural purposes. Its weight is about 67 lbs. per cubic foot and the trees obtain very large dimensions. The biggest specimen recorded had a height of about 200 feet, with a clear bole up to 125 feet and a girth of over 40 feet, 12 feet from the ground. There are several other hardwoods which are not far behind *chengal* in point of value. Of the medium hardwoods, that known as *Meranti* (*Shorea* of many species) is the most abundant and most useful. It is used generally for purposes for which coniferous woods are used in temperate climates.

Of the minor forest products, Gutta percha is perhaps the most interesting. By the uninitiated, Gutta percha is generally confused with rubber, to which product it is chemically allied, but from which it differs in many respects. It is not elastic and though it becomes soft when heated, it does not become sticky. Its peculiar value lies in its excellent quality as a material for electrical insulation, and its resistance to acid reactions. It was the former of these qualities which made it of such great importance in the construction of submarine telegraph cables, for which purpose it is unrivalled. Until comparatively recently no other substance was used for this purpose, but of late years *balata* has also been used, generally in admixture with Gutta percha. It is produced by trees of the Genus *Palaquium*, the best quality being obtained from *P. gutta*, or *P. oblongifolium*, which are found only in the Malay Peninsula, Sumatra and some of the adjacent islands.

Large areas of forest in which Gutta percha occurs naturally mixed with many other species, have been reserved and some 37,000 acres have been treated silviculturally with the object of increasing the proportion of Gutta percha trees. At the present time, however, Gutta percha is rather at a discount, owing to the development of wireless telegraphy, and the consequent decline in submarine cable manufacture. However, cables are by no means obsolete, and if Gutta percha can be produced at a moderate price, and if regular supplies can be assured,

its peculiar qualities may be relied upon to extend its range of usefulness and to maintain the demand.

Reference has been made above to the appointment of the first forest officers. Since then the organization and personnel of the forest department has steadily grown. In 1902 a trained and experienced officer was obtained from India and appointed Conservator of the four Federated States, and since then the senior branch of the service has been recruited only from fully trained men. A general research branch has been established and also a special branch to deal with the important subjects of timber testing, exploitation, and utilization. These branches are being developed on the most up-to-date lines. A sawmill is in course of erection equipped with all the most modern appliances, including a timber impregnation plant.

The extension of the forest organization involved a very large increase in expenditure, but this was accompanied by a corresponding increase in revenue. The financial results in 1928 were as follows:—

Revenue	...	...	£212,919
Expenditure	...	...	£147,315
Surplus	...	...	£65,604

These figures refer only to the Federated States, and the expenditure does not take into account pensions or leave pay.

Revenue is not, of course, the only criterion of the value to country of organized forestry, in fact it may be said that present revenue is not the most important value. While seeing that the Government of to-day gets a fair share of the value of the forest produce now being consumed, the Forest Department is at the same time, by its control and exploitation, preventing waste of material available for immediate use. It is, moreover, by silvicultural treatment continually improving the reserved forests with the object of increasing the yield of timber per acre for the use of future generations.

The Government has declared its policy that the country shall be self-supporting as regards timber. It is impossible to forecast what the local demand for timber may be in the distant future, but there is no doubt that with good management the forest resources are equal to any demand that is likely to be made on them, and it is probable that in years to come there will be a surplus of certain kinds of timber available for export.

The first steps towards establishing an organized forest service have been mentioned above. At the end of 1928 the Senior Staff numbered forty-three, the middle and subordinate staff exceeded 500, exclusive of clerks and daily paid labour. The authority of the Conservator of Forests of the Federated States has been extended to the Straits Settlements, that is to

say to Penang, Singapore, Province Wellesly, Malacca and the Dindings. Officers are seconded from the Federated Malay States to the Unfederated States of Kedah and Johore, both of which now have forest departments of their own. The States of Kelantan and Trenggann, which are also outside the Federation, for financial reasons have not at present any forest officers. It is known that they have considerable areas of valuable forest and it is intended to bring these under proper management as soon as possible. For the present they are fairly safe, owing to their inaccessibility.

For a man who is really interested in forestry and who has a good constitution, the Malay Peninsula is a most attractive field. It is necessary to stress the good constitution for the work is often arduous and good staying power is needed. The forest officer's life is, nevertheless, a pleasant one and full of interest, especially to those who have a taste for outdoor life and natural history. Anyone who may wish to have further information on the subject should call at the Malayan Information Agency, *Malaya House, 57 Charing Cross Road, London, S.W.1.* (*The Journal of the Cambridge University Forestry Association, Vol. IV, No. 1, 1929.*)

NORTH-WEST FRONTIER PROVINCE.

SWAT FORESTS.

The attitude of the Wali of Swat was unexceptionable throughout the year. Good progress was made during the summer months in the preparation of a working plan for the Swat forests. Following the Wali's example, both the Mehtar of Chitral and the Nawab of Dir have agreed to the inspection of their forests by a Government Forest Officer, and it is hoped to depute an officer for this purpose in the near future. A preliminary inspection of the valuable Kalam Utrot deodar forests in Swat Kohistan, was carried out during the year.

What is more important, a large and representative Jirga of tribes inhabiting these parts visited Malakand in April 1928, and agreed to the introduction of measures for the conservation of their forests and to the establishment of political contact with the Government by the appointment of a Tehsildar at Kalam. A contract concluded by them with Messrs. Spedding, Dinga Singh and Company for the working of the forests under Government control has also been approved—(*The Pioneer*).

THREE TIGERS AND A PANTHER.

SHIKAR NEAR DEHRA DUN.

A shooting party out in the Barkot forests round Dehra Dun had some extraordinary luck recently. A beat was organised, chiefly for small game,

birds and jungle *moorghi*. Apart from birds in plenty, no less than four tigers and a panther were turned out from a fairly narrow area.

Of the tigers one was bagged by Major Hind of the 2nd Gurkhas, one by Mr. Osmaston of the Imperial Forest Service, and the third between Col. Chope and Col. Ross of the 2nd Gurkhas. Amongst the party was General Ironside, Commanding the Meerut District.

This is exceptional luck for a single day's *shikar* in these parts—(*The Pioneer*).

TIGERS ATTACKING ELEPHANTS.

DEPREDACTIONS IN LOWER BURMA.

The attacks of tigers upon their working elephants have occasioned serious losses this year to Messrs. Foucar & Co., of Rangoon, who hold a lease of the teak forests in the South Pegu Forest Division of Lower Burma, and Mr. G. G. Warton of the firm, has very kindly given me the following details which I think will be of interest to readers of *The Field*.

It was on December 27th, 1923, that the first attack was made by two tigers, believed to be male and female, on the Kyunwi stream in the Kadat Reserve. A fine tusker 8 ft. 6 in. was bitten behind the shoulder blade right down to the vertebrae and one of the intervertebral discs was torn. The elephant died three days later.

Another elephant, a small cow, was mauled, having her ears chewed and scratches all down both rumps. This elephant recovered. On the same night another small female elephant belonging to another contractor whose camp was not far away was attacked and clawed down the back and rumps; she was caught next morning a good distance off in a very nervous condition.

On the next night, December 23th, 1923, an old pensioned elephant named Palumai Gyi, a large tusker, was attacked near the firm's forest headquarters at Taikkyi. He was bitten in the same way as the other tusker, just behind the shoulder blade, one large mouthful leaving the vertebrae exposed, both ear flaps were torn, and deep scratches down both sides and rumps.

The poor beast died whilst Mr. Warton was dressing his wounds on the evening of January 9th, 1929. He was attacked at a place where he had been sleeping, so it is quite possible he was set upon whilst asleep. The tracks of two tigers were seen, so they were evidently the same two that attacked the contractor's elephants some three miles away.

On February 20th, 1929, a forester, whilst coming through Compartment No. 35, South Zamayi Forest, came across the remains of a dead female elephant which had evidently been killed, as the bones were strewn about. These were the remains of an old pensioned female elephant, Mai Choe. She was probably killed about Christmas time.

Early in March two cane cutters were attacked as they were returning to their camp in the evening. One of the men slashed the tiger on the head with his *dah*. Both men were mauled and one eventually died. On May 3rd a report was received that the body of a tiger had been found in the same stream. It had *dah* cuts on the head, and was evidently the same beast that attacked the men in March.

On April 8th a female elephant named Moliana! Galay was attacked by a tiger whilst feeding with her new-born calf in the North Zamayi Reserve and was bitten on the trunk but fortunately not seriously.

On April 12th a buffalo was killed near the place where the first tusker was killed in December. One of the head foresters sat up over the "kill" and shot a male tiger measuring 8 ft. 7 in. This is most probably one of the tigers that killed the elephants.

Mr. Warton advances the theory that the old elephant Mai Choe was first killed, and the tigers having found her an easy prey and having got a liking for elephant flesh, were led to attack the other elephants.

The fact that tigers frequently kill elephants has often been recorded, but it is not often that a full grown tusker is the victim. Last year, another firm of teak lessees had very heavy losses among their elephants from tigers. Tigers habitually kill baby elephants, and the attitude of the mother is always to me a matter of some surprise.

Even a jungle fowl will show fight in defence of its brood of chickens and will not leave them, but a cow elephant will nearly always stampede with the herd and leave its baby when alarmed and, when the latter is attacked by a tiger, the mother does not appear to take any defensive measures.

In the Annual Report of the Uganda Protectorate Game Department for the year ending December 31st, 1925, it is recorded that lions in Uganda habitually kill young elephants, but I do not think it probable that lions have ever succeeded in killing a full-grown African elephant—(*The Field*).

THE NEW INDIA HOUSE.

INDIAN TIMBERS IN THE ALDWYCH BUILDING.

The interior work at the new India House in Aldwych is now so far advanced that plans are being made for the office of the High Commissioner for India to be transferred there in the second week of March. In any case, the present inadequate accommodation in three houses adapted from dwellings in Grosvenor gardens must be vacated.

The total vote of the Legislative Assembly for the building and furnishing of this new accommodation for the "agency" work of the Government of India, as distinct from the political functions of the India Office, was £324,000, and it is not expected that any supplementary vote

will be required. The interior arrangements are planned to reduce to a minimum the cost of upkeep. Thus the water supply is entirely independent of municipal service, being obtained from two artesian wells sunk some 480 ft. below the basement where the central heating apparatus is installed. The walls of corridors, etc., are of an imitation marble which can be readily cleaned. The use throughout of Indian hardwoods, chiefly *gurjan*, for flooring, obviates the need for any floor covering. From basement to roof scarcely any wood of non-Indian origin is employed. For panelling and decorative purposes silver grey, koko, laurel, and the beautiful dark red *padank* have been used.

The large use of Indian timbers is typical of the care taken to provide, subject to the inevitable limitations of a building in the heart of London, an Indian atmosphere. Some account of the exterior decorations was given in *The Times* of January 7, but note may be taken of the symbolism of the 14 plaques running from the main entrance door in Aldwych. Twelve are occupied with the respective arms of the nine major provinces and three provinces administered by the Government of India, while two are for the present left vacant.

In the exhibition hall on the ground floor are recesses, after the style of an Indian bazar, for special exhibits. In the octagonal entrance hall and the gallery round the central dome on the first floor are delicate carvings made by Indian workmen at Delhi from Makara marble. The walls of the staircase and the halls are of redstone, similar in appearance to the Agra and Delhi sandstone, carved and worked in the geometrical patterns familiar in Indian architecture. The domes and vaults are designed for painted decoration by specially selected Indian artists now undergoing training in technique in this country and Italy. The spacious library on the second floor has in the centre the beautiful balustrade of the central dome, carved at Delhi and giving in the 18 facets illustrations of the principal products of India.

The High Commissioner and his personal staff, together with the Trade Commissioner and his assistants, will be housed in beautifully panelled rooms on the third floor. Much space is occupied on the ground floor and elsewhere by the Accounts Branch, which is responsible for the payment of pensions, leave allowances, and salaries of civil officers of Government, and provision on a generous scale is made for purposes connected with the expansion of India's trade. The interior, with its white walls and large windows, has been so designed as to secure the maximum amount of daylight—(*The Times*).

ESTIMATION OF FORWARD ALLOWANCE.

SIR,—In the answer to the question on Forward Allowance at Long Range, under "In the Gunroom" of your issue of January 17th, in

describing the most generally recommended method of shooting, you state the trigger should be pulled "when the gun is pointing well ahead of the bird"—how much ahead is, of course, the crux of the matter—and add: "It is impossible to judge any particular number of feet as a forward allowance . . . It is doubtful whether any shooter can tell to yard, let alone to a foot, what forward allowance he gives. He is merely conscious of swinging well through."

This touches on a point which has always interested me, viz., some practical method of estimating with sufficient accuracy to assist a shooter a certain number of feet at a certain range. I recognise, of course, the impossibility of devising any rule or method to cover all cases—all the various angles and the various speeds—if it were possible there might well be no birds to shoot and there would certainly be little pleasure in shooting but it has always seemed to me that, if some practical means of estimating what is, say, 8 ft. at 40 yds., could be devised, that would be at any rate one basic fact for a shooter to go on.

It occurred to me recently that the apparent width of the barrels at the muzzle might provide such means. I therefore got a friend to measure the distance from my eye to the muzzle of my gun (which has 28 in. barrels), and found it to be 34 in. I also had measured the *apparent* width of the muzzle (not quite the same as the actual width), and found it to be nearly exactly 1½ in. By simple proportion I deduced that, for birds crossing at 40 miles per hour, pointing the gun so that there was, between the bird and the outside of the muzzle nearest to it, a clear space equal to the apparent width of the muzzle the forward allowance actually given differed from the correct allowance by less than 1 ft. 4 in. for all ranges up to and including 50 yds.

My calculation for 40 yds. range was as follow:—

Distance from eye to muzzle : Distance from head to line from eye
to bird : Range : Forward Allowance actually given :

$$\text{or } \frac{34}{\frac{1}{2} + 1\frac{1}{2}} = \frac{40 \times 36}{x}$$

where x is the actual forward allowance in inches, whence $x = 7.9$ ft.

Similarly for a bird crossing at 60 miles per hour, if the gun be pointed so that there is *twice* the apparent width of muzzle between the outside of the muzzle and the bird, the forward allowance will be correct for all ranges up to 50 yds within a maximum error of 1 ft. 6 in.

I append a table, and should be interested to hear your criticism of the idea involved, in particular, in which cases you consider, taking into account the spread of the shot at the various ranges, the application of the "rules" would ensure a clean kill.

Bird crossing at

40 miles per hour.				60 miles per hour.		
Range in yards.	Correct forward allowance.	Allowance given by clearance of width of muzzle.	Error.	Correct forward allowance.	Allowance given by clearance of twice width of muzzle.	Error.
	ft.	ft.	ft.	ft.	ft.	ft.
20	3.4	4.0	+ 0.6	5.2	6.6	+ 1.4
25	4.5	5.0	+ 0.5	6.8	8.3	+ 1.5
30	5.6	6.0	+ 0.4	8.5	9.9	+ 1.4
35	6.8	6.9	+ 0.1	10.3	11.6	+ 1.3
40	8.2	7.9	- 0.3	12.3	13.2	+ 0.9
45	9.6	8.9	- 0.7	14.5	14.9	+ 0.4
50	11.2	9.9	- 1.3	16.9	16.5	- 0.4

Incidentally, a few trial pointings of a gun will show, I think, the apparently large allowances—on which I note you frequently insist—necessary for fast birds at long ranges.

MAYMYO, BURMA.

V. H. T. FIELDS-CLARKE, I.F.S.

[We have heard this suggestion, and others similar to it, advanced several times before, and one device was actually patented for which great claims were put forward, but which was really a variation of the principle which our correspondent puts forward. It is possible that this method of shooting might help some sportsmen for crossing birds but it would certainly make others check their swing and "poke"; while even those who could adopt it would find it of no help in the case of overhead birds. On the whole, we are quite convinced that the best way to shoot is to swing through without any attempt at an estimation of an allowance of any particular number of feet. It is the difficulty of shooting which is one of its greatest charms and shooters should always remember that a long shot needs plenty of swing through.—Ed.]—(*The Field*).

INDIAN FORESTER

MAY 1930.

GMELINA PLANTATIONS AT THE BAWDWIN MINES.

BY F. ALLSOP, I.F.S.

The problem of the supply of 20,000 tons of timber annually to Messrs the Burma Corporation, Limited.

I. INTRODUCTION.

The lead and silver ores in the Bawdwin Mine, which is situated in the Shan hills about 200 miles north-east of Mandalay, have been worked for the past five centuries, first by Chinese, whose present borders are only fifty miles from the mine, and since 1891 by European firms. It is recorded that political troubles in Yunnan, the province of China which adjoins this part of the Shan States, and engineering difficulties which arose as the workings became deeper, caused the withdrawal of the Chinese in 1870. Under the present lessees, Messrs the Burma Corporation, Limited, the annual production of refined lead has risen to over 77,000 tons and the mine now ranks as one of the most important sources of this metal in the world. In addition about 7,400,000 ozs. of refined silver and large quantities of partially refined zinc and copper are exported each year. The outturn of ore from the mine amounts to 440,000 tons per annum.

The Corporation has installed the apparatus for milling smelting, and refining the whole of its output of lead and silver and for dealing as far as required with the by-products. In addition it maintains forty-five miles of two-foot gauge railway

which connects the mine with the metre-gauge line of the Burma Railway. The whole tremendous organisation has been imposed on a tract completely undeveloped and inhabited chiefly by Shan and Kachins, tribes who subsist principally by shifting cultivation and are backward to a degree. Hence electric power, the housing of its staff, roads, water-supply and every other detail in the tract which concerns it has had to be dealt with by the Corporation, which has now established what amounts to an industrial town in the midst of the jungle.

II. TIMBER SUPPLIES.

During the development of the mine and the operations subsidiary to it the forests have played an important part as sources of timber and firewood. Near Bawdwin itself the hills are devoid of tree-growth, owing, in all probability, to the cutting of fuel by the Chinese and the destructive effect of the fumes from their smelting operations. The whole of the surrounding country is, however, fairly well wooded though the forest is not of good quality. The principal species are *Terminalia tomentosa*, *Pentacme suavis*, *Lagerstroemia tomentosa*, *Anogeissus latifolia*, *Dillenia pentagyna*, *Bombax malabaricum*, *Sterculia* spp., *Quercus* and *Castanopsis* spp., and a little *Pinus Khasya*, but devastation, by shifting cultivators, a feature of the whole of the Shan States, is as conspicuous in the neighbourhood of the mine as elsewhere. Some 105 square miles of the better quality forest have been reserved, but even this area contains a proportion of secondary growth and is said to yield on the average only $2\frac{1}{2}$ tons per acre of timber suitable for the Corporation's use. The surrounding country cannot be reserved owing to the claims of the native tribes to continue their traditional practices and a considerable wastage of valuable material ensues.

The consumption of timber by the mine and the various works connected with it has increased greatly during recent years and now exceeds to 20,000 tons (round) per annum. This material is absorbed, for the most part, in timbering the mine, and its main desideratum is strength rather than durability or beauty. There is at present only a comparatively small demand

for firewood as hydro-electric power, coal and oil-fuel are used in the plant and locomotives. The mine timber consists of pit props and rough converted material the annual consumption of the latter being some 17,000 tons (round). Short lengths only are required, 7'4" being the maximum length of converted mine timber employed.

At the present rate of consumption it is estimated that the existing forests, some 550 square miles which have been leased to the Corporation, will have been worked over in 7 or 8 years, and, though the reserves have nominally been worked under coppice with standards and coppice systems at various times, the amount of regeneration of useful species is not by any means adequate for future requirements. It is estimated, however, that some 5,000 tons per annum will be available from the second growth on areas previously worked. The life of the Bawdwin Mine as a source of ore on the present scale of production is thought to be considerably more than the life of the existing forests and the Corporation has had to consider its timber supply for the future. The necessity of seeking the material it requires in the rich forests in other parts of Burma would add considerably to its costs of production. The mine is situated in a remote corner, in hilly country, and the carriage of timber as well as the multitudinous other materials which have to be brought in by the 600 miles of railway which connect it with Rangoon would, it is thought, be impossible. The track from Bawdwin to Mandalay is already working at high pressure.

III. THE FOREST.

The greater part of the forest accessible from the mine would be of no economic value if the mine did not exist and the formation of a forest reserve in the neighbourhood was carried out entirely in the interests of the Burma Corporation. Now that their leased area is approaching exhaustion the problem of its regeneration has had to be faced. Only reserves could be considered and experiments were begun in the reserve nearest to the mine, the Panghai Reserve. It is obvious that the method of regeneration to be adopted must be one that would give

results within a very short time and that the prospects of success with natural regeneration were extremely small. Artificial regeneration by the *taungya* method was, therefore, attempted.

The species to which the locality appears most suited are *Terminalia tomentosa* and *Pentacme suavis* but neither grows sufficiently rapidly there for it to be considered in the regeneration scheme as it was essential to produce utilisable material in the shortest possible time. Of the rapid growing species found near the mine *Gmelina arborea*, *Albizia procera*, *Duabanga sonneratioides*, *Bombax* spp. and certain of the *Sterculiaceae* suggested themselves as capable of producing utilisable material of 3'3"—4' girth in 15 years. Most of the timber was stated to be required for six months only in temporary galleries which would be filled with earth and rubble after the removal of the ore. Permanent galleries in the mine are made of masonry. The Corporation mining engineers however emphasised the fact that a minimum of strength was essential and stated that, of the trees mentioned, only *Gmelina arborea* fulfilled their requirements in this respect. Many of them had had experience of *Eucalyptus* spp. in Australian mines and, in 1920, when the Corporation first showed apprehension for their future timber supplies they suggested that they should undertake the regeneration of areas of unclassed forests near Namtu with species of *Eucalyptus* of which *E. globulus* was the most favoured. On taking advice of Australian foresters, however, it was found that they generally preferred *Eucalyptus saligna*, *E. citriodora*, *E. maculata* and *E. pilularis* for planting near Namtu. The characteristics of the climate are tropical, the main features being:—

Approximate latitude..... 23° North.

Altitude..... 1,800—2,500 feet.

Average rainfall..... 68" per annum, the fall being almost entirely confined to the period from May to November.

Temperature range..... 45°—95° F.

It was thought that trees from the tropical and sub-tropical parts of Australia would be better suited to the condition than *E. globulus*. No planting was actually undertaken by the

Burma Corporation, but experiments in the regeneration of the Panghai Reserve were begun by the Forest Department in 1921. The forest in which the work was done consisted partly of areas of secondary growth after shifting cultivation and cutting of fuel, and partly of areas which had been cleared of large trees of useful species by the Corporation. The growth consisted, for the most part of soft wooded species of *Sterculia*, *Bombax*, *Grewia*, *Kydia*, etc., but in the areas which had not suffered from the *taungya* and fuel cutter there was also some bamboo, chiefly *Dendrocalamus membranaceus* and *D. Hamiltonii*. Generally speaking, bamboo forest occupied the better soils. Much of the forest is very open and has been invaded by *Imperata arundinacea* and other grasses, including *Rottboellia striata*.

IV. REGENERATION OPERATIONS.

Attempts were made to regenerate this forest by cutting and burning the existing growth and planting up as in the *taungya* method, but usually without the use of field crops. It was extremely difficult to induce the local inhabitants to take up areas in the reserve for cultivation on the condition that they planted trees in their *taungyas*, so that, after clearing, the methods of a regular plantation were employed.

The work of the first few years, which included experiments with *Eucalyptus siderophloia*, *E. resinifera*, *E. tereticornis*, *E. propinqua*, *E. globulus*, *E. saligna*, *E. maculata*, *E. citriodora*, *E. corymbosa*, and *E. rostrata* as well as a number of native species including *Cedrela Toona*, *Chickrassia tabularis*, *Gmelina arborea* and others, gave only the scantiest of positive results.

In 1925 the actual regeneration which had been achieved as a result of five seasons' work was a mere 60 acres consisting almost entirely of *Gmelina arborea*, but it had been found that among the species tried those likely to do good were *Gmelina arborea*, *Eucalyptus citriodora*, *E. saligna* and *E. maculata*. It was stated that all these, which are fortunately quick growers, were suitable for use in the mine and steps were taken to work up to the regeneration area theoretically required to produce 15,000 tons of mine timber of 3' 6" - 4' 0" b.h.g. per annum. The remaining 5,000 tons

required could, it was thought, be obtained from the second growth on areas cut over in the past. In 1926 and 1927, 105 and 192 acres were regenerated, the proportion of *Eucalyptus* being 17 acres in the first year and 47 in the second, the remainder of the area being *Gmelina arborea*. *E. saligna*, *E. citriodora* and *E. tereticornis* gave good results, but the difficulty and expense of establishing all species of *Eucalyptus* were so great that they were abandoned in favour of *Gmelina arborea*. One of the most important factors against the use of *Eucalyptus* was the damage by white ants, which killed off trees as much as 4 years old and 4" or 5" in b.h.g. as well as freshly planted seedlings. When, in 1928, an attempt was made to regenerate the maximum area of 350 acres, *Gmelina* only was used.

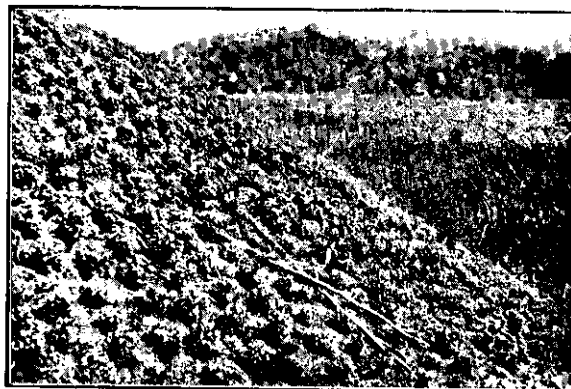
Tolerably successful results were obtained by the use of this species, regeneration taking place at two centres and being carried out by methods which may be of general interest and possibly merit a detailed description. The areas chosen for regeneration are cleared by a contractor in January, as in the *taungya* method, and the debris left lying till the end of March, when it is burnt. A good fire is essential to success and the weather, which is distinctly erratic in the Shan hills, must be carefully watched to ensure that the fire takes place before the first showers of the monsoon occur. Then a contractor is again admitted to pile up and burn any combustible material that remains and to fence the area. Staking parties follow the contractor's men. It has been found that 6' x 6' is the most suitable spacing. *Gmelina arborea* is introduced by a number of methods, the most successful, being:—

(a) the use of transplants aged about 5—6 weeks reared in nurseries and put out as soon as the rains commence in earnest, usually about the beginning of June, and

(b) the use of "stumps" (root and shoot cuttings) of one or two year old trees, planted out towards the end of April. These are particularly effective in areas on which *Imperata arundinacea* has taken a hold, as they appear, on the whole, to make better progress there than do transplants, though their growth is inclined to be irregular.



Photo, 7th July 1929.
Gmelina arborea, 1929 Plantation,
Compartment 19, Panghai Reserve.
Sown 29th April 1929.



Photo, 12th September 1929
Gmelina arborea, General view of 1929 Plantation,
Compartment 11, Panghai Reserve.



Photo, 13th September 1929.
Gmelina arborea, 1929 Plantation, Compart-
ment 19, Panghai Reserve.



Photo, 12th September 1929.
Gmelina arborea, 1929 Plantation, Compart-
ment 11, Panghai Reserve.

Staff marked off in feet.

The sowing of seed at stake and the use of 6 months old transplants have been tried with results which are less consistently good than those given by the two methods described above. Owing, however, to the large size of the area, it is not easy to give all parts the marked advantage which accrue from early planting if one method alone is employed, so that upwards of 100 acres each year is sown at stake in April and the blanks patched at convenient times during the rains. By these methods it has been possible to complete planting and patching of blanks before the end of June. A stocking of 85 per cent. and upwards is considered satisfactory and can be obtained by patching, about three weeks after planting out, the few blanks which generally occur in transplanted areas. Every effort is made to obtain good stocking as early as possible in the first rains, as patching of blanks in the second year has never been very successful.

On the greater part of the area taken up for regeneration during the seasons of 1928 and 1929 the growth of *Gmelina* has been extremely satisfactory. In the first rains, as is shown by the photographs in plate 27 a height of 5 or 6 feet is attained, the best trees reaching as much as 9 feet. They produce strong side branches, and though considerable attention must be paid to weeding in the first year, in many parts of the plantation one weeding is sufficient in the second year, when an average height of 15' or 16' is reached. If this progress is maintained, as it has been in the 12 acres of *Gmelina arborea* planted in 1924, there is every prospect of producing timber of suitable size for use in the mine at the time when supplies from natural forest will be running short. The side-branches die off naturally as the trees grow up and the 1924 plantation is beautifully clean and well-grown. This plantation was given what was considered to be a fairly heavy thinning in 1928 and it has produced a number of trees 40' to 50' high and 1' 8" to 2' b.h.g. at the age of 6 years.

During the past two years a few *taungya* cutters have been recruited and it has been possible, with their help, to obtain successful regeneration over some seventy acres in the 1929 plantation. The technique of the work is now fully understood

and the use of the *taungya*-cutters is desirable only to reduce the cost of the work. Labour near this large industrial centre is expensive and the average cost of the 1928 and 1929 plantations has been approximately Rs. 78 per acre (exclusive of overheads and fire protection) and there appears little prospect of reducing this figure under the system of regular plantations. It is estimated that by clearing his *ya* free of cost, planting it and keeping it weeded the *ya*-cutter saves the Department some Rs. 50 per acre, and efforts are being made to introduce this economical method of working over as large an area as possible. Attempts to do so in the past met with very little success and usually seem to have resulted in the clearing of an area and the cultivation of field-crops without raising a tree-crop. This has certainly not been the case during the last two seasons and photograph No. 3 which is taken in a *taungya* shows that the cultivator can raise trees quite as good as those found in other parts of the plantation.

The large areas of pure crops which are being produced are, it must be admitted, liable to epidemic diseases and some pests, notably *Dihammus cervinus*, a borer, and *Calopepla leayana*, a defoliator, do occur, but their depredations have not yet assumed serious proportions. By carrying out regeneration at two centres and providing occasional breaks of unregenerated forest it is hoped that serious epidemics will be avoided.

By no means all the Panghai Reserve is suitable for plantations of *Gmelina*, but stock-mapping revealed that there is ample area available to regenerate at the rate of 350 acres a year for at least 15 years and the Working Plan which came into operation in 1929-30 prescribes this amount. In the absence, therefore, of any unforeseen catastrophe, the Corporation's supplies of mine timber are assured for the whole life of the Bawdwin Mine, as there should be no difficulty in regenerating the recently planted areas by coppice in the next rotation.

With regard to the finance of the plantations, it is assumed that the cost per acre, including fire protection, overheads and tending charges for the first five years will be about Rs. 195, a

tentative figure which has been arrived at on the basis of past and present charges but which cannot be regarded as more than an estimate. At the end of 20 years, therefore, the cost per acre will be Rs. 518, allowing 5 per cent. compound interest on the money invested. The estimated annual expenditure for 350 acres is Rs. 68,250.

The finance of the operations has been worked out and under arrangements now in progress with the Corporation an economic return on the invested capital is assured, provided the plantations are successful

DESCRIPTION OF THARRAWADDY DIVISION.

Tharrawaddy Division—pronounced Thar-ra-waddy and known by its inmates and intimates as Tharrabludywaddy—may well claim to be the premier Division of Burma. Much of the early history of the Forest Department in Burma centred round Tharrawaddy, and it has usually taken the lead in the introduction of new methods of treatment. It formed one of the six Divisions into which the forests of Lower Burma were divided in 1856, when the first working plan was drawn up. There have been several changes in the area of the Division since then, the last change being in 1905, when the old Tharrawaddy Division, which then coincided with the District of that name, was split into the Zigon and Tharrawaddy Divisions, the present Tharrawaddy Division comprising the southern portion of the district.

The Division is about 40 miles in length from north to south and stretches from the summit of the Pegu Yoma—the watershed between the Irrawaddy and the Sittang rivers—to the eastern bank of the Irrawaddy. The western two-thirds are composed of a wide stretch of level country, mostly paddy plain, between the foot of the hills and the Irrawaddy. The original headquarters of the Tharrawaddy Division were at Myanaung on the river. In 1860 Sir Dietrich Brandis moved the headquarters to Myodwin where the site of his office is still preserved. Myodwin, now in the Zigon Division, became one of the earliest active centres of teak plantation under Brandis. Later the headquarters were

moved back to Myanaung for 3 years. In 1879 the district headquarters were formed at Tharrawaddy and the headquarters of the Division have been there ever since.

Tharrawaddy is situated at the southern end of the Division in the Plains and is connected by the Rangoon-Prome branch railway line and a metalled road with Rangoon. By road it is 78 miles from Rangoon, but what is still more important to the tired Divisional Forest Officer, it is only 64 miles from Mingaladon, the course of the Rangoon Golf Club. During the rains, when life in Tharrabludywaddy is mouldy, many a Divisional Forest Officer has blessed Mingaladon and returned refreshed in mind and body, in spite of the club bar, after a week end at that delectable spot.

After hearing all about the delightful climates of Himalayan Divisions in recent numbers of the *Indian Forester*, one may well pass over the description of the Tharrawaddy climate with a pang of envy for the mountaineer foresters of the Himalayas. It usually deserve its pet name of Tharrabludywaddy. Even so there are points about it; there is sometimes a month or so of cool weather and the rains if wet are fairly cool. During the hot weather all the streams are dry and the water supply is often a difficult problem.

The main block of forests, called the Yoma forests, stretches along the entire length of the eastern part of the division and covers all the hilly portion. Further west there are detached reserves called Plains Reserves, the isolated remains of the almost solid forest through which Brandis marched from Sanywe on the Myitmaka river to Myodwin. Even as late as the nineties of last century virgin forest was being cleared all round Tharrawaddy town for cultivation, and firewood, now only obtained with difficulty, was a glut on the market. The Rangoon-Prome railway line and metalled road run closely parallel through the centre of the Division from north to south, and three District Council branch roads run out towards the reserves. District Council roads are called "Dyarchy" roads in some parts of Burma. When they are good they are not too bad but when they are bad, as they too often are, they are horrid.

West of the railway flows the Myitmaka, which, lower down with some assistance from the Irrawaddy, becomes the Hlaing or Rangoon river. During the rains the Myitmaka is swollen by overflow from the Irrawaddy and floods a wide stretch of country. This flooded area is called the "*laha*", and jungle streams from the hills, on entering the still water of the "*laha*" during these floods, deposit silt which forms considerable obstacles to floating when the floods subside. These silt deposits are called "*thegaws*". To overcome this difficulty and stabilise the floating streams, river training was started about 1914 by F. A. Leete, later Chief Conservator, and carried on by G. C. Cheyne, I.F.S., then Timber Assistant in the Zigon Division. As a result of this work, the methods evolved have now been adopted by Government on a large scale for land reclamation in other parts of the Province as well, and the Department is very proud of its Mr. Cheyne, now the River Training Expert with the rank of a Superintending Engineer, who is showing the Public Works Department how to do it. The hill portion of the Division drains into the Myitmaka by four main streams—the Minhla, Mokka, Billin (in two branches, the Konbilin and Kadinbilin) and the Thonze. It is only the first two on which river training has been carried out to any great extent, and the bulk of the important river training work has been carried out on the streams further north in the Zigon and Prome Divisions.

The total area of forests in the Division is 480 square miles, of which 324 square miles are classed as "Yoma" or hill reserves, 21 square miles as "Plains" reserves, and 135 square miles of unclassed forests. The unclassified forests are a rapidly wasting asset and, with the exception of a certain amount of teak forest interspersed with cultivation, contain little timber of much value. The underlying rock over the greater part of the hilly portion of the Division is the Peguan series of alternating sands and shales, and the type of forest follows very closely the distribution of these strata; dry upper mixed deciduous forest growing on the stiff soil caused by the decomposition of the shale, and moist upper mixed deciduous on the loamy soils of the sandstone. These are the two principal types of forest which occur in the

Division, in both of which teak is the outstanding tree. They are both characterised by a dense growth of bamboo, *hmyinwa* (*Dendrocalamus strictus*) in the drier forests and *kyathaungwa* (*Bambusa polymorpha*) in the moister forest. In addition to these main types, lower mixed deciduous, midway between dry and moist upper mixed deciduous but characterised by an absence or sparseness of bamboos, also contains teak in some quantity. There is also evergreen in the south of the Division and a type of dry *dipterocarp* forest known as *indaing* in drier areas, sometimes on laterite.

The Province of Pegu in which Tharrawaddy is situated was annexed in 1852. Prior to this extraction of teak was practically uncontrolled, though teak being a royal tree the Burmese King took his tithe of the outturn. This was collected on the streams by agents who also supplied the buffaloes for extraction. Under this system, the smaller girth classes in accessible forests near the main streams were seriously depleted. In 1856, the first rough Working Plan was drawn up for the whole of the teak producing forest in what then formed British Burma. It was revised in 1868 as a result of valuation surveys and more accurate data of the rate of growth. In 1884—1887, detailed Working Plans, the first of their kind in Burma, were drawn up for each of the five main blocks of hill reserves in the Division, based on an enumeration over 25 per cent. of the area. The Selection System was prescribed. In the meantime plantations were started in the Kadinbillin reserve in 1867. At first these were regular plantations, but under the guidance of Col. W. J. Seaton, who was first Divisional Forest Officer and later Conservator from 1863 to 1870, every encouragement was given to the Karens, a jungle tribe living by shifting cultivation (*taungyas*) in the forests, to plant up teak in their *taungyas*. The first *taungya* teak plantation was made in the Division in 1869 as a present to Brandis by a Karen headman Mg. Pan Hle. Actually the first *taungya* plantations in Burma appear to have been made in Toungoo. The area planted annually showed rapid progress until 1905 when the policy veered round to improvement fellings, mainly owing to the great

difficulty found in adequately tending the large area of scattered plantations. By 1918, which marks the start of modern concentrated regeneration, about 14,000 acres of plantations, mostly teak, had been formed. At the first Burma Forest Conference held in 1910 it was decided to adopt the method of concentrated regeneration, advocated by Troup, then Imperial Silviculturist, in the revision of the Working Plan for Tharrawaddy. Field work was done during the seasons 1911—13 by E. V. Ellis, but before the plan could be drawn up the War had intervened. Ellis, then on leave, joined up with the Naval Brigade, and after seeing much service in Gallipoli and France during which he was given the M. C., he died of wounds early in March 1917. In the meantime the final drafting of the Working Plan had resulted in considerable discussion. At one time it was proposed to cut down the original proposals of the 1910 Conference and only to adopt the new system over one comparatively small and inaccessible block of the hill forest. However, wiser counsel prevailed and in 1918 the new plan was finally approved.

Under the 1918 Working Plan the rotation was fixed at 120 years and regeneration was prescribed on 1,100 acres a year, selection working of teak being continued over the forest not allotted for regeneration in the first 20 years. At first the method of regeneration was to be largely experimental, repeated improvement fellings, mostly in the lower mixed type, which were started by Walsh in 1911, having proved to be very successful in bringing up a young crop of teak and *pyingado* (*Xylia dolabriformis*). The immediate success of the revival of *taungya* plantations in Tharrawaddy, however, revolutionised methods of regeneration in Burma and most of the more accessible divisions have to a greater or lesser extent followed the lead given by Tharrawaddy. In this swing of the pendulum the establishment of existing natural reproduction by improvement fellings was rather lost sight of, but it is now realised that each method is applicable in its proper place, the *taungya* plantations in heavy bamboo forest and concentrated improvement fellings mainly in the lower mixed and drier types where natural reproduction

is usually present. Recently the Working Plan has been revised at the end of the first ten years. Apart from forming a selection working circle for the less accessible forest and thus considerably reducing the annual regeneration area, the system of concentrated regeneration is continued, though the actual methods of regeneration are far more defined on the basis of 10 years experience.

A more recent development is the intensive planting of the isolated Plains Reserves. Owing to the cultivation of the surrounding country interfering with the natural drainage, many parts of these reserves are now flooded in the rains, affording an extremely difficult problem of regeneration. Experiments in planting with field crops were started in 1917 and have resulted in considerable success in all but the most swampy areas. The most successful field crops in these areas are sugar-cane and vegetables, such as brinjal. A Working Plan for these reserves was drawn up in 1922 by A. P. Davis and has now been incorporated in the revised Divisional Working Plan.

As a result of work since the introduction of the concentrated system in 1918 over 6,000 acres have been planted in the Division and the total area of plantations on the 31st March, 1929, stood at 20,844 acres, the average cost of formation and upkeep to date being Rs. 28 per acre.

Extraction of teak is all done by Government, the agency being the Myitmaka Extraction Division under the Utilization Circle, which also works the teak forests of Zigon and that portion of the Prome Division falling in the Myitmaka drainage. Until 1920 extraction of teak was controlled by the Divisional Officer assisted after 1912 by a Timber Assistant who was in special charge of this work. All the best teak is floated out to the Myitmaka where it is rafted to Rangoon and sold at the Government Depôt, Ahlone.

Extraction of other timbers is carried out by purchase contractors.

The gross revenue of the Division averages about Rs. 4½ lakhs with a surplus of rather over Rs. 2 lakhs.

The Division is well furnished with communications but in the rains the clay soil, which seems to predominate on all roads and paths, renders touring by elephant essential; as it is the whole year in the less accessible and more hilly portions of the Division. In 1929 the first metalled road made by the Forest Department in Burma, 8 miles long, was completed from Hmawin to Nyaungbinzin, rendering it possible to go out to the edge of the hill forest in the southern part of the Division by motor-car from headquarters in under an hour. Another metalled road is projected to connect the northern portion of the Division with the main Rangoon-Prome road and railway line. This will do away to a large extent with the hot and tiring marches across the paddy plain that separates the hill forests from the main road and railway and will allow of a considerable extension to the areas accessible to extraction by carts.

These are numerous, there being four quarters for Gazetted Officers, ninety-four subordinates' quarters, and twenty-four Forest Rest Houses. Also a Range Officers' Club, and a Forest Department Dispensary under a Sub-Assistant Surgeon. The latter is comparatively new, but is doing very stout work.

Organised forest labour exists in a number of forest villages introduced as a result of the concentrated work started in 1918. Most of these villagers cut *taungyas* and make plantations. Villages formed definitely for the supply of labour on other works have so far not been very successful. The Burman enjoys felling trees, but does not like work involving a mamootie. It is usually possible, however, to get sufficient labour for road work without having to import Indian labour, which has not been found satisfactory.

Tharrawaddy Division does not take a very high place as regards *shikar*. The snipe season is short and grounds are few. Jungle fowls give sufficient interest to an evening stroll

or beat round the paddy fields in January and February. There is a fair amount of big game,—bison, *saing* and tiger,—in the less accessible parts, but the Divisional Forest Officer does not get many opportunities to visit these parts at all frequently. An occasional rhinoceros (*R. sumatrensis*) may be found at the foot of the Yoma. There used to be a fair number of elephants, but these seem to have decreased considerably of late years. The nearest approach to fishing is prawn-nesting in the trees in what was once the Athayaw Reserve, but has since been disforested where water in the rains is several feet deep.

The social amenities of the Division are not great, but to anyone keen on his job, Tharrawaddy is full of interest. Most of those who have been in charge of the Division look back on their time there with pleasant memories. Tharrawaddy is the headquarters of three Divisions including the Myitmaka Extraction Division and at times one could rely on meeting a cheerful crowd of forest officers in headquarters. There was always Mingaladon or Rangoon to fall back upon for odd week ends when all else failed and Tharrabludywaddy was more than usually b——y.

“PAST AND PRESENT.”

ELEPHANT CATCHING IN ASSAM.

BY A. J. W. MILROY, I.F.S.

Elephants are caught in two ways in Assam, by *Mela shikar* and by Kheddahs. Under the former method the wild herds are chased by the tame elephants until a bewildered calf is cut off and can be noosed. A nooser (*phandi*) rides on the neck of each tame elephant (*koonkie*), while a second man stands or crouches on the elephant's back balancing himself by means of a small rope attached to the elephant's girth; with his free hand he goads the elephant near the root of the tail whenever it slackens its pace.

Kheddahs are managed on smaller and more economical lines in Assam than in many parts of India,

A stockade is built across a well-defined elephant path leading from one feeding ground to another or, more commonly, on one of the paths radiating out from a salt lick. The site selected is always in dense forest so that the stockade is not easily visible, while it is considered an advantage to choose a place for the gate where the path passes between two large trees which can serve as door posts. Stockades are usually rectangular or oval, about 30 yards by 22 to 25 yards, and the palisade is protected on the inside except at the gate by a ditch about 7 feet wide and 5 feet deep. Drop gates have been abandoned in favour of gates which swing-to from the inside on the rope, which holds them open, being severed by a watcher posted in a *machan*. This *machan* is often built close to the entrance, but this is a mistake as the elephants are less willing to enter the stockade if they catch the human taint right in front of them, and it should be well to one side. A palisade like a wing extends outwards from each side of the gate to prevent elephants from trying to get round the stockade, and to guide those which stray from the path back towards the entrance. The stockade, wings and doors are carefully concealed by means of creepers and orchids, and during the building of the stockade care is taken not to disturb the jungle growing in the middle, except that it is necessary to remove all trees which are small enough to be knocked down by the elephants but large enough to damage the stockade wall. Elephants can be successfully driven during the day from one feeding ground to another especially in hilly country where the steepness of the locality prevents them from breaking away in all directions. Some 7 to 10 men suffice for the driving, and others are required to block all paths except the one leading to the stockade. The elephants are best brought along quietly with no more noise than an occasional tap-tap on a tree until the herd has entered the wings, when a gun is discharged to stampede them forward pell-mell through the narrow entrance. Salt licks are only visited by the elephants during the late evening or after dark. It is necessary to dispose of the drivers so that the elephants can approach the lick without suspicion; the men then creep to

their stations noiselessly, a difficult operation which is facilitated by maintaining paths cleared of obstructions and daily swept clean.

Stockades have to be built some little way from licks or the elephants would pick up suspicious smells, so it is necessary, consequently, to get them moving quietly and slowly from the lick in the desired direction and to avoid any stampeding, or it would be impossible in the darkness to prevent the herd from scattering and breaking away. A gun is fired and torches are lit as soon as the herd has entered the wings.

The *koonkies* are brought up as soon as possible after a catch has been made, the ropes fastening the gate are loosed, the biggest *koonkie*, preferably a tusker, throws it open and stalks in followed closely by the others, the gate being shut on the heels of the last one.

The first *koonkie* makes straight for the biggest and most truculent-looking wild elephant, which is usually over-awed by the appearance of determination and combination exhibited by the men-impelled *koonkies*, and the herd is soon being hustled round the stockade, and thereafter shows no fight at all apart from occasional assaults delivered by $3/4$ grown tuskers. Big males are shot as soon as they enter the stockade as there is no local custom of men dodging in and roping their legs, and they would be too dangerous for the *koonkies* to tackle if left unfettered. The wild elephants are noosed without much difficulty by the *phandies*, the big animals requiring two, three and even four *koonkies* to hold them, in which case two are attached to the neck and the others to legs.

The wild elephants being still full of vigour, it is desirable to tie them up as near as possible to the stockade to prevent them pulling the *koonkies* about. Having arrived at the selected spot the *koonkies* huddle in against the wild animal's stern to allow men operating under their (the *koonkies'*) bellies to rope and tie the hind legs to a tree; the front legs are left free, but a rope attached round the elephant's neck is fastened so high up on a tree in front that, while the captive can kneel down and

even stand on its head, it cannot get the slack of the rope into its mouth to bite it. Secured in this way the elephants struggle all night and tire themselves out, which is just what is wanted, but it takes too long however to do this every day on the march to the depot. So the elephants are then tied close up to a tree, round which the neck rope is passed five or six times, allowing the elephants to run round and round as they please. The bark has first to be removed from the tree to prevent the rope from being chafed, and projecting roots cut away lest the animal should injure its toe-nails by kicking at them in its anger.

Training commences as soon as an elephant has been sold. The animal's fore and hind legs are tied to trees so that it is in an uncomfortable stretched position and its neck is fastened close up to a post in order to curtail the range of its head and trunk; rope harness consisting of girth and crupper is then fitted.

A number of men armed with torches and sticks approach after dark singing and shouting and proceed to rub the elephant's skin anywhere that is out of reach of the trunk; the animal objects violently but is unable to do any harm, the man in front jabbing it with his torch every time its trunk threatens, while those on the flanks or in the rear punish each demonstration of rage with their sticks. After a short while a man climbs up on to its back to be followed by one or two others, while the elephant screams with fear and anger. The performance is repeated nightly until the captive pays no heed to the men's attentions.

The next rope should be loosened after the training is over in order to allow the elephant to lie down, should it want to, and removed entirely if the skin of the neck becomes chafed. In the same way the leg ropes have to be secured higher or lower above the ankles and kept in place so as to allow galls to dry up and heal.

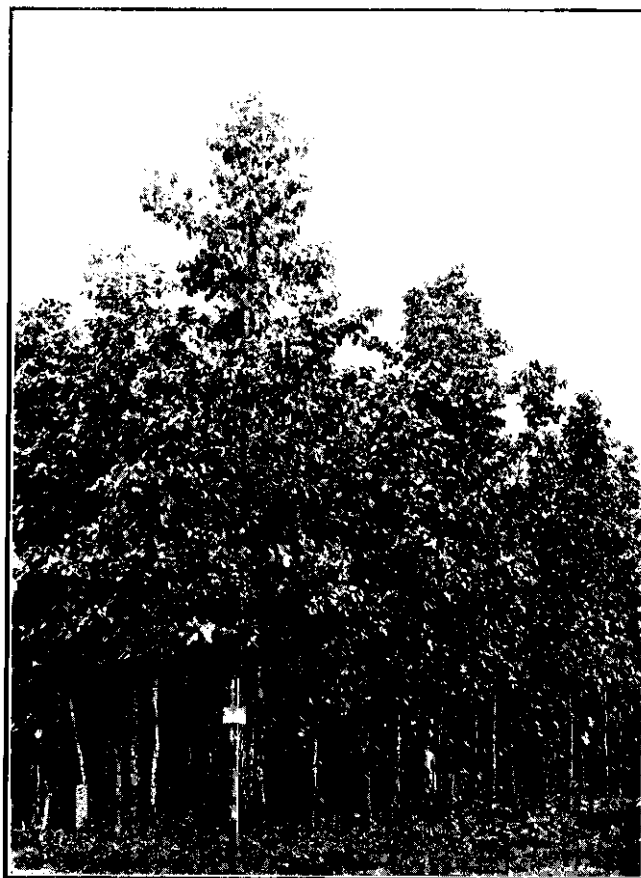
Next morning the new elephant is led out closely tied by the neck between two *hoonkies* with men carrying sticks walking

in front and behind. The trainer climbs up on to one of the *koonkies* and from its back leaps on to the pupil, retaining his position by clinging on to the harness. The elephant is well castigated by the men in front and behind if it should try to shake, a dangerous habit that has to be discouraged. The two *koonkies* proceed forward at the loudly shouted word of command and at the same time the trainer gives his charge a sharp poke with a stick at the back of its ears; the halt is taught by the clout between the eyes administered at the moment the *koonkies* halt, and so on with the change direction and, if the term is admissible, the reverse.

The rope from one *koonkie* is lengthened after a couple of days and the *koonkie* itself dispensed with after about the 4th morning, the second *koonkie* doing nothing more than hover in the back ground after the 8th to 10th day. It is reckoned that elephants can be managed entirely without the help of the *koonkies* in from 14 to 21 days, depending on their size, by which time it is safe to entrain them for transport to their purchasers' homes. Ropes are always fastened high up round the stifle to curtail the length of stride so that the elephant cannot manage more than a slow shuffle even if trying to bolt.

In former days spears were used where only sticks are now allowed, and it has been found that casualties from septicaemia have become negligible, while the animals are tamed and trained just as quickly and effectively.

An elephant is taught to kneel by men hauling on ropes attached to its fore and hind legs, while a sharp pointed stick is thrust between the shoulder blades by the mahout; to lie down in water for its bath by being pushed over slowly by a *koonkie*, and to pick up anything from the ground and hand it to its mahout by having a sack on a string dangled in front of it. Indeed the only really difficult trick to teach an elephant is that of taking water up in its trunk and blowing it along the top of its head and back for a final rinse after bathing.



Photograph of 1920 Plantation, Panchanai (Sukna, Kurseong).
Taken on 29th June 1928. Species: Sal. Area 40 acres,
the bottom of the plantation notice board is 5' 6" from the
ground level

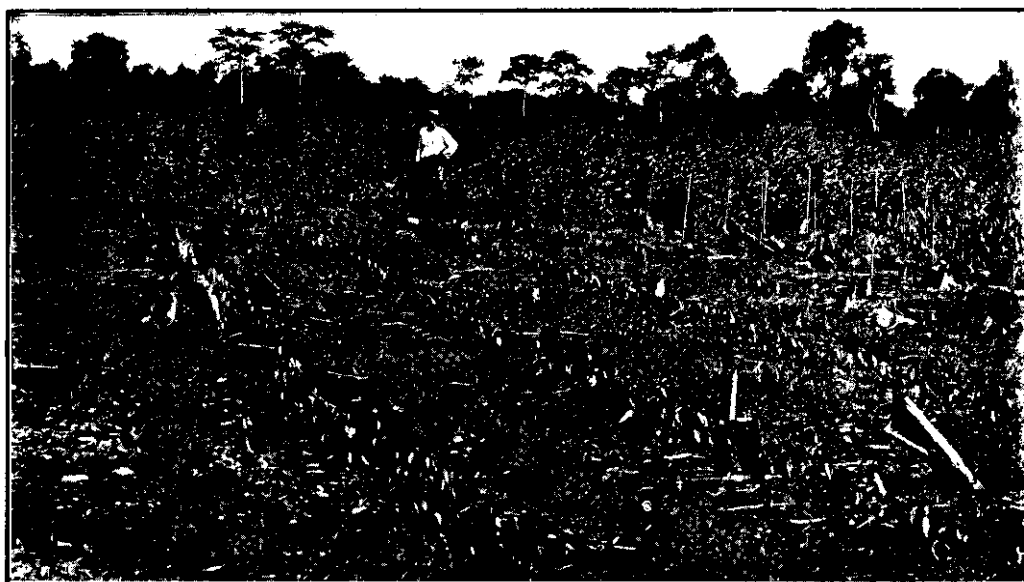


Photo. 29th June 1928.

KURSEONG DIVISION.

Photograph of 1928 Plantation, Hatisar (Sukna).

Area 52 acres. Jute crop 2 months old, sal 3 weeks old and boga medeloa 2 weeks old.

**REVENUE AND EXPENDITURE ON DEPARTMENTAL
JUTE (FIBRE AND SEED) GROWN AT SUKNA,
KURSEONG DIVISION, BENGAL.**

By T. M. COFFEY, I.F.S.

The following are the details per acre :—

No.	Details.	Cost per acre	REMARKS.
		Rs. a. p.	
1.	Hoeing the area broadcast (once for jute 12" deep, at Re. 0-0-6 <i>luggi</i> (12' × 12', = Rs 9-8-0 ... say	10 0 0	April.
2.	Cost of jute seed, 4½ seers per acre <i>Capsularis</i> sp. at Rs 20 a md. = Rs. 2-4-0 per acre. <i>Oltorius</i> sp. at Rs 25 a md. = Rs 2-13-0 ... say	2 8 0	
3.	Railway freight on jute seed, and carriage to coupe ...	0 4 6	
4.	Jute sowing ...	0 4 0	Beginning May.
5.	Jute 1st thinning, and sal 1st hand weeding combined, whole area at Rs 0-0-3 <i>luggi</i> = Rs. 4-11-9, say Rs. 4-12-0, charge ½ to jute, i.e. ...	2 6 0	Mid-July.
6.	Jute 2nd thinning for retting; this includes retting, fibre extraction and drying the fibre ready for sale. ...	15 0 0	2nd week September; main crop after thinning left for seed.
7.	Harvesting jute for seed and loading at railway station (Agricultural Department supplies sacks free) ...	17 0 0	November.
	Total expenditure ...	47 6 6	
	Revenue from above.		
1.	Jute fibre, from thinnings only; see item No. 6 above; 3 mds. per acre at Rs. 10 per md. ...	30 0 0	
2.	Jute seed, 4-5 mds. per acre; average 4½ mds. <i>Capsularis</i> sp. = Rs. 20 a md. and <i>Oltorius</i> sp. = Rs 25 a md.; average = Rs 22-8-0. 4½ mds at Rs 22-8-0 = Rs. 101-4-0—say ...	100 0 0	
	Total Revenue ...	130 0 0	
	Profit on jute per acre = Rs. 130 —Rs. 47-6-6 = Rs. 82-9-6.		

The total cost the first year for everything (plantation, jute, new fencing, inspection paths and notice boards) is Rs. 92-11-9. Therefore the profit on the plantation = Rs. 130 minus Rs. 92-11-9, i.e., Rs. 37-4-3 and you are left with a sal plantation and wove and barbed wire that will last another 8 or 10 years.

N.B.—I have been reminded that in the same Division and same season another Range Officer put out his sal at a loss of Rs. 93 an acre; from this it may be gathered that with departmental field crops, particularly jute, an exceptionally good Range staff is necessary.

LUCHON'S NEW BATH CHAMBER.

By C. DUPRE THORNTON, I.F.S. (RETIRED).

Nature and science have been combined in a remarkable manner at Luchon for the cure of human ills. Here the healing waters, which a bountiful Providence has caused to gush forth from the deep recesses of the Pyrenean rocks, are controlled and turned to man's use by the engineer and the scientist.

Two thousand years ago the Romans began the work, as is testified by the many votive tablets dedicated by grateful convalescents to their tutelary deities, and still preserved in the Museum of Toulouse.

Yet another step forward will be represented in the opening in June 1930 of the great new Vaporarium, which is the only one of its kind in the world. Huge chambers have been blasted out under the mountain of Superbagnères to form a gigantic natural Turkish bath in which 300 patients can be treated simultaneously. The work, carried out with the utmost care and caution, has occupied several years.

The thermal springs of Luchon are hot and cold sulphurous waters with every degree of sulphuration and varying in temperature.

Some of these springs are radio-active, others contain iron and silicates. The so-called *humage* treatment, which means

both dry inhalations and fumigations by natural dry vapours, will be superseded by inhaling the natural vapour which exudes from the rock in the Vaporarium.

Cleansing process.—The action of the sulphurous fumes and waters is cleansing and purifying, as well as healing and drying. In the Vaporarium the humage and Turkish bath system will be carried out on an extensive scale.

The heat of the waters and vapours is entirely natural, and it is most interesting to see the steaming hot water gushing forth from the rock. Luchon is visited by the deaf, and many miracles of healing have been wrought by the treatment, which is carried on by specialists of European note.

All catarrhal affections, ailments of the nose, throat and bronchial tubes are treated with great success. So, too, are skin diseases and rheumatism.

The charm of the treatment is its naturalness. Here Nature is indeed "man's most kindly nurse". The romantic situation of the fine Thermal Establishment adds to its attraction. Richly wooded mountains rise all around, with snow-flecked rock peaks guarding the frontier between France and Spain. Two passes lead to Spain through the mountains and can be crossed on foot by good walkers, or on horseback by those who do not fear a rough bridle path. These are the wild Port Venasque and the beautiful Col de Portillon. A new road is being built over the latter pass, which will considerably shorten the motoring distance to Barcelona.

Good motoring roads already run from Luchon to Montréjeau, where the local railway line joins the main lines to Toulouse and Bordeaux. One can also motor right through the mountains to Cauterets and Lourdes. There are daily motor-car excursions to these places, and also to the famous Cirque de Gavarnie.

The Vallée du Lys, another beauty spot, lies behind Superbagnères, the mountain spur rising immediately above the town of Luchon and in winter a famous centre for snow and ice sport.

Any reader who may wish to take this cure can obtain further information on writing to Dr. Molinery, Technical Director of the Thermal Establishment at Luchon, who can furnish several pamphlets about Luchon and the benefits to be derived from the treatment. He has also published a long, descriptive article about Luchon and the new Vaporarium in the "Journal des Sciences Médicales de Lille" of the 1st September, 1929.

I should also be glad to give any information to other officers (Civil or Military) who have retired from India, if they write to me to the following address, but I would prefer to give them personal information about it should they come to Nice between November and May any year, or after that at my Club, L'Union Interalliée, 33, Faubourg St. Honoré, Paris:—

C. Du Pré Thornton, Indian (Uncovenanted) Civil Service Retired, C/o Barclay's Bank, 7, Promenade des Anglais, Nice, A. M., FRANCE.

Summer is the best time for a "cure" at Luchon (2,000 ft.) preferably from July 15 to September 15.

There are also Winter Sports at Superbagnères (6,000 ft.), which is connected with Luchon by a funicular railway. There is an excellent hotel there with a lovely view of the Pyrenees.

MUSINGS OF AN HIMALAYAN JUNGLE.

BY NARANJAN SINGH.

Oh, think of the past. I cannot do so without a shudder passing through me. My God, that indiscriminate destruction of my offspring immature and mature alike. Verily my human neighbours acted as their own enemies by very nearly slaying me. They did not realise that without full and vigorous life in me how could I give them good timber and a constant supply of it, how could I retain my sponge humus to absorb water and ensure constant spring and river supply, and how the velocity of

rain water was to be retarded and the plains saved from destructive floods. By my death even the soil over my bosom might have been eroded and my animals, beautifully plumaged birds and others, might have had to go together with that fine picturesqueness which my very existence offers. I was being axed, axed and axed and would have disappeared but for the timely coming of Jungle Ka Mahkima, may God bless it and its founders.

I have a history to tell since the inception of this department. First a very wise officer came along and fixed for the axe only those of my offspring which had reached maturity and gave only sufficient light to enable me to rear up fresh ones in the bared places. The trash resulting from conversion was collected and burnt up. Optimum light, the coming of rains, and good seed from my healthy and robust children soon endowed me with a fine new crop on a considerable portion of my body. The unfavourable places received artificial help and I had a full-fledged new generation all over.

Then manicuring began. In early stages inferior plant neighbours competing with my young ones were rooted out. Later on my inferior and diseased young ones even were removed to let my healthy offspring grow unimpeded. My old sons have all disappeared by now.

Later still keen competition grew between my healthy offspring even and to remove overcrowding certain of these had to be taken out to leave me really the best and of course the optimum number for rearing to maturity, so that I might give the utmost possible return commensurate with my perpetual existence.

Fire and growing dangers became practically unknown to me. Some times if I had any malady, forthwith came a doctor from the hospital branch of Tree Institute at Dehra Dun, attended to it and saved me from further harm.

In fact I am now fairly on the way to my previous natural grandeur—thanks to the efforts of the department. Neither have my human neighbours suffered by the new régime. They are given all what they want for themselves but of course in a methodical way and without endangering my existence.

EDITORIAL.

BAMBOO SEED.

The Divisional Forest Officer, Chittagong, Bengal, reports that *Dendrocalamus longispattus* bamboo (local name *orah*) is now in flower.

ELEPHANTS IN SOUTH INDIA.

Description of a rogue by a Tahsildar :—

"The single tusker is about 15 feet in height, broad 10 feet and length 12 feet. Its colour is black and its tusks are $1\frac{1}{2}$ feet in diameter. Its length is $2\frac{1}{2}$ feet. It roams about chiefly in Kandadimale of Kiribag beat. It has destroyed 4 big cocoanut plants on the bund of the field of Hosavakklu Thimmappa Gowda. On the 2nd it came to Kunheti Ramappa Gowda's garden and destroyed 1 cocoanut tree and 1 arecanut tree."

The elephant must have been some prehistoric mammoth returning to its old haunts.

REVIEWS.

FIFTH ANNUAL REPORT OF THE IMPERIAL FORESTRY INSTITUTE, UNIVERSITY OF OXFORD, 1928-29.

Lord Clinton, the Chairman of the Forestry Commission, ends the Preface to this interesting report with the following words.

"Hitherto the Institute has been handicapped by inadequate accommodation and a lack of funds. Want of space has necessitated the diversion to the purchase of buildings of funds which should have been devoted to staff and equipment; this has hampered the work of the Institute in no small degree, and the progress made in spite of this handicap is therefore the more striking. It is hoped that the resolutions of the Empire Forestry

Conference will result in the removal of these difficulties so far as annual maintenance charges are concerned. Equally important, however, is the question of buildings, for which a sum of £100,000 will be required. Until this sum is forthcoming the work of the Institute, which is carried out in temporary and unsuitable buildings, will continue to be prosecuted under great difficulties."

We understand that India, Canada, Australia and other parts of the Empire have been asked to guarantee the funds required to put the Institute on a sound footing, both as regards the sums necessary for the annual upkeep and also in order to enable proper buildings to be erected. In the interests of the important forests of the Empire, it is most desirable that these funds should be provided. It is quite evident from the report that the research and instructional work carried on at the Institute attain a level that cannot be attained anywhere else in the Empire and there can be no doubt that the value of the Institute for the various forest departments will increase year by year. It is regrettable that the number of post-graduate probationers and forest officers on leave from India, who attended the courses of study, was very small, amounting only to four out of a total of thirty. The other students came from East, West and South Africa, Malaya, Ceylon, Mauritius, Great Britain, Cyprus, Trinidad, Canada, Australia and the United States of America.

This is not very creditable to the largest and most important forest department in the British Empire.

A feature of the work at the Institute is the instruction given on the continent of Europe which is described as follows:—

"Continental Work.—Continental tours were carried through in the Easter and summer vacations. At Easter a party of eleven proceeded with Mr. Glasson to Germany and in company with Dr. C. A. Schenck, to whom special thanks are due, visited selected forests. The other party was with Mr. Bourne and was engaged in the preparation of a Working Plan. This latter tour was completed by a visit to the Maritime pine forests in the Landes. In the summer the party was at first divided, some proceeding with Mr. Lloyd to selected forests of Northern France,

while the remainder carried out the reconnaissance survey already mentioned. On the completion of the survey all those who remained on tour proceeded with Mr. Bourne through the French and Swiss Jura and finished with a visit to Zurich.

Special acknowledgments are due to the Forest Services in France, Germany and Switzerland, without whose cordial co-operation these tours would be impossible. The close personal contact which has been established with so many individual officers is as pleasing as it is invaluable, and it is a gratification to know that this feeling is reciprocated. It is also a pleasure to record that the intelligent interest and good discipline displayed by the students on tour has contributed in no small measure to this result. But while the local officers feel that all the extra work and time taken up on these tours is justified, it is fair neither to the Institute nor to the Officers concerned to ask them to arrange tours at other times. It is essential, therefore, that officers on leave wishing to undertake visits to the Continent should arrange for their deputation to coincide with the dates fixed for these tours, and that visits of individuals or of small parties at other times cannot be countenanced except in very special circumstances."

We would particularly invite the attention of readers of the *Indian Forester* to the Director's remarks at the end of the above extract.

The various Readers of the University are called upon to give instruction in special lines, such as Climatology and Forest Soils, Silviculture, Management, Botany, Wood Technology, Entomolgy, Mycology, Forest Economics, Utilization, Surveying and Engineering are all adequately dealt with by the whole-time or part-time staff.

A new experimental garden was started in June 1925 at Kennington near Oxford where methods of rearing trees, the control of oak mildew in the nursery, the development of trees in early life under conditions of severe competition and research into the root action of seedlings, and the influence of various types of humus were investigated.

Lord Clinton describes the publication work of the Institute as follows :—

“ The results of work carried out at the Institute are published in various scientific and technical journals, but papers of a sufficiently comprehensive character appear in the series of *Oxford Forestry Memoirs* (Clarendon Press), of which nine have appeared so far, and three more are in course of publication. The publication of these Memoirs began in 1922 in connection with the Oxford School of Forestry, but in 1925 the editorial business was taken over by the Institute. Another series has recently been started, namely, the *Oxford Manuals of Forestry* (Clarendon Press), of which one (Troup's ‘Silvicultural Systems’) has already appeared and a second (Hiley's ‘Economics of Forestry’) is in the press”.

It is gratifying to read that public have begun to come to the Institute for information and that the number of enquiries is rising year by year.

The following was the constitution of the Staff during the year :—

DIRECTOR.

Professor R. S. TROUP, C.I.E., M.A., D.Sc. (Oxon.), F.R.S.

LECTURERS AND DEMONSTRATORS.

Silviculture : THE DIRECTOR: A. K. GLASSON, M.A. (Oxon.), (B.A. Cantab.) (till 25th June, 1929); H. M. STEVEN,* B.Sc., Ph.D. (Edin.), Hon. M.A. (Oxon.), Forest Commission Research Officer attached to the Institute.

Economics of Forestry : W. E. HILEY, O.B.E., M.A. (Oxon.).

Forest Management : R. BOURNE, M.A. (Oxon.).

Mycology : W. R. DAVY, B.Sc., M.A. (Oxon.).

Structure and Properties of Wood : L. CHALK, M.A., D.Phil. (Oxon.).

Entomology : R. N. CHRYSTAL, B.Sc. (Edin.), Hon. M.A. (Oxon.).

Forest Botany : J. BURTT DAVY, Hon. M.A. (Oxon.), Ph.D. (Cantab.); E. E. KIRBY, M.A. (Cantab.) (till 25th March, 1929); A. C. HOYLE, B.A. (Oxon.) (from 31st May, 1929).

(* Part-time Lecturer.)

Surveying: M. O'C. TANDY,* D.S.O., O.B.E., M.A. (Oxon.).

Forest Engineering: A. H. LLOYD, M.C., M.A. (Oxon.).

Forest Law: H. S. WILLIAMSON,* M.A. (Oxon.).

Secretary: P. S. SPOKES, B.Sc., M.A. (Oxon.).

Librarian: Miss G. GUINEY.

We look forward to the time when the Institute will have succeeded in obtaining the requisite funds and when it will take its place, not only as the best staffed, but also as the best equipped and best housed, Forestry Institute in the Empire.

(* Part-time Lecturer.)

ELEMENTS OF FORESTRY.

BY FRANKLIN MOON, B.A., M.F.,

Dean, New York State College of Forestry at
Syracuse University,
and

NELSON COURTLANDT BROWN, B.A., M.F.,
Professor of Forest Utilization.

Second Edition, New York, John Wiley and Sons, Inc.
London, Chapman and Hall, Limited. Price 17s. 6d.

This volume of 400 pages may usefully be introduced by the following words from the preface:—

“Noted for rapidity in organization, the American people, since the first National Forests were created some thirty years ago, have quite surpassed themselves with regard to the profession and theory of Forestry, although its practice is a variable quantity”.

It is stated that the chief point of difference between the lumberman and the forester is that the latter recognises growth as a function of the forest while the lumberman usually overlooks this factor and makes no provision for future crops. This appears to us a mild way of describing the American lumberman whose principal function is usually destruction. It will be of interest to see how the learned authors treat the various divisions of their subject, which has already a very large literature in many languages.

Silvics as a science apparently means the knowledge of the life, development and need of the various trees, but silviculture mean the art of tending the forest. This part of the subject is not handled in any great detail.

Silvicultural systems are described under several heads, for example "Systems of Natural Reproduction" are somewhat inadequately described under the following headings:—

Selection system; Clear cutting systems; Shelterwood system; Coppice (or sprout) system.

Improvement cuttings are divided into:—

Cleanings; Liberation cuttings; Thinnings, Damage cuttings.

It seems a pity to introduce new terms when old established and well understood terms are available.

Artificial regeneration takes a good deal of space and Protection (especially fire protection) is briefly described.

On the utilization side we have Lumbering; Wood Utilization; Wood Technology; and Wood Preservation but none of these subjects are treated in any detail.

Similar short accounts of other aspects of forestry in America complete this useful elementary Handbook. The bibliography is adequate.

CORRESPONDENCE.

NOTICE.—Correspondents who wish their letters to appear in a particular number of the *Indian Forester* should ensure that they reach the Honorary Editor by the 15th of the previous month with a request to that effect.

FIFTH INTERNATIONAL BOTANICAL CONGRESS TO BE HELD AT CAMBRIDGE IN 1930.

SIR,—On the occasion of the Fifth International Botanical Congress, to be held at Cambridge from August 16th—23rd, 1930, it is proposed to hold an informal conference on the Systematic Anatomy of Wood. The subject is rapidly increasing in importance, particularly in relation to the identification of timber. The numerous anatomical descriptions of timbers, which have been published of recent years, direct attention to the lack of

EXTRACTS.

THE COWDUNG PROBLEM.

We cannot help feeling grateful to the happy chance that threw the September number of the *Indian Forester* in our way. Sitting down to a cup of afternoon tea, we took it up with no particular purpose and the opening article held our attention so firmly that the tea got cold before we remembered that it was there. It appears that Mr. Chaturvedi had given birth to an idea in the shape of a solution of the cowdung problem, and it was on the correlation of that idea with facts that the author of the article, Mr. E. C. Mobbs, of the Indian Forest Service, offered some observations. Everyone knows that cowdung is a problem of considerable importance; there are 150,000,000 cattle in India, besides millions of sheep, goats, horses and donkeys, and what should be manure for the soil is used for fuel. It is one of the reasons, the soil being impoverished, why the lives of the people are one desperate struggle against poverty. Mr. Chaturvedi says that there are always some lands near every village which

lie fallow as unfit for agricultural purposes, by which is meant, presumably, the *shamilat deh*, the common grazing land of the village, "grazing," by courtesy, for the scanty pasture it yields is shown by the ribs of the starving cattle. But Mr. Chaturvedi would apparently have this waste land afforested by the cultivators, and in return they would be allowed to cultivate free between the rows of trees. The village forests would then satisfy the fuel requirements of the villages and all the cowdung would go into the soil. The picture is so Utopian that it almost takes the breath away.

Forest felling refuse provides fuel, Mr. Mobbs says that in charge of a Himalayan Division he once calculated that the refuse of his deodar areas of one year alone, would supply enough fuel to keep all the fires of an English house going all day throughout the year for two hundred years. But then these Himalayan forests are inaccessible and the transportation of the refuse as fuel is impracticable. In the village forests of the plains it would be different, the fuel would be at the people's doors. That is a point, but would the villagers on that account come forward in large numbers and give their labour free to plant the wastes? Would there be very much of forests on the *shamilat deh*, remembering that the cowdung problem is most intense in the more densely populated parts of the plains, where culturable land is in strong demand and where unculturable waste is really unculturable? Would it be any incentive to the people that they could cultivate free of charge between the trees, what would be the boundaries of their plots, and would there be any crops to speak of on land on which all the village cattle were at liberty to graze? Assuming that the forbidding-looking communal lands were suitable for afforestation, would the village *panchayats* be able to cope with the rights of individuals, or would Government officials, however enthusiastic for the job, care to take it on? The Indian villager is, moreover, very conservative and has an affection for his cowdung. It is not merely that he likes to plaster his floors with it, to mix it with mud for his walls, and to use it for his little fires whence the glowing cowdung particles are put into *hukkas* to give the tobacco a flavour and to make it go a little further. All that might pass, but dung used as a fuel is a habit of ages. Wood may be plentiful, and dung is preferred. Vessels of unglazed pottery, used for cooking, will not always stand a fire fiercer than the smouldering glow of dung; wood requires constant attention, and the housewife likes a fire on which she can put her pot to simmer, and go off to the fields or to the well or other occupations, knowing that all will be well when she returns. And, in addition, there is in cowdung a lucrative business, it is not only used by the villagers, in villages, it is taken to and sold in neighbouring towns. Village forests would have to supply the requirements of the rural population and to augment the fuel needs of towns which have been to some extent dependent on the cowdung trade.

No one is going to deny that Mr. Chaturvedi's conception for the release of cowdung for manure for the fields, is a matter of first importance

in the interests of the agriculture of India. It would add unquestionably to the yield of the crops now cultivated in anxiety and to the prosperity of a toiling people; but it is a long long way to Tipperary, and it can only come by patient effort in the cause of the moral advance of the people whose welfare it is sought to promote. The cultivator has a natural distrust of innovation and of administrative activity in his behalf, but he is shrewd enough in matters that come within his comprehension, and in course of time he is bound to become a more enlightened agriculturist. In the meanwhile, in connection with Mr. Chaturvedi's solution of the problem, there is Mr. Mobbs' article which is capital reading. It could hardly have been done better, and our only grouse about it is that, arresting our attention as it did, we found our tea cold!—(*Indian Engineering*.)

THE TANNING VALUE OF ANOGEISSUS LATIFOLIA LEAVES.

Anogeissus latifolia Wall, is a large deciduous tree, known as "Dhawa," which occurs in the Sub-Himalayan tract from the Ravi eastward and also in Central and Southern India. The leaves and twigs of this tree are used locally as a tanning material under the name of "Country Sumac," but do not appear to be employed at the present time in any tanneries run on modern lines in India. In view of the promising nature of the material, the Advisory Committee on Tanning Materials of the Imperial Institute suggested that a supply should be obtained for detailed examination in order to determine its suitability for use as a tanning material in the United Kingdom. A supply of the leaves was subsequently received for examination at the Imperial Institute, from the Forest Range Officer, Madura, Madras, through the agency of the Forest Research Institute, Dehra Dun.

It was pointed out that in the past great difficulty had been experienced in preparing the leaves on a commercial scale. It was considered necessary to dry the leaves in the shade in order to obtain material of the best quality and this could only be done with considerable trouble, since the leaves ferment rapidly with consequent loss of tannin. Owing to this difficulty of drying, the collection of the leaves, which had been undertaken by the Forest Department in Madras in 1918, had to be abandoned.

The samples of *A. latifolia* leaves received at the Imperial Institute were as follows:—

Sample A.—Pale brownish-green leaves from 1 to 2 in. long; the majority of the leaves were broken. The sample was free from stalk, and in good condition.

Sample B.—Leaves similar to *A* but somewhat lighter in colour and larger, being from 2 to 3 in. long.

Sample C.—This was labelled "Dhawa sumac," and consisted of young leaves and twigs, mostly broken, and ranging from brownish-green to reddish-brown in colour. The unbroken leaves measured from $\frac{1}{2}$ to $\frac{3}{4}$ in. in length. The sample was in good condition.

The two samples of leaves, *A* and *B*, were stated to be similar, and to consist of a mixture of leaves collected on September 30, 1927, and June 7, 1928; the sample of Dhawa sumac was collected on the same days.

RESULTS OF EXAMINATION.

	Leaves. (A) Per cent.	Leaves. (B) Per cent.	Dhawa sumac (C) Per cent.
Moisture	12.8	12.3	14.0
Insoluble matter	44.3	44.5	33.7
Extractive matter (non-tannin)...	10.0	11.0	13.8
¹ Tannin	32.9	32.2	38.5
Ash	4.4	3.9	4.0
² Tintometer readings:			
Red	1.5	1.7	1.9
Yellow	4.9	5.0	6.5

¹ The determination was made by the method prescribed by the International Association of Leather Trades' Chemists (Hide Powder, Batch B. II).

² Determined for a solution containing 0.5 per cent. of tannin in all centimetre cell.

The leather produced by tanning split calf skin (grain side) with infusions of the three samples had the following properties:

Sample A, Leaves.—Pale greenish-buff leather, soft and of firm texture

Sample B, Leaves.—Slightly darker leather than that produced by Sample A, and almost devoid of greenish tinge; of firm texture, but not quite so soft as A.

Sample C, Dhawa sumac.—The leather was generally similar to that produced by Sample A.

The results of the examination show that all three samples contain high percentages of tannin, the "Dhawa sumac" (young leaves and twigs) being particularly satisfactory in this respect. In each case the amount of soluble non-tannin extractive matter is advantageously low. The leather produced by the three samples was generally similar, of light colour and good quality.

The leaves of *Anogeissus latifolia* compare very favourably as regards their tannin content with true sumac (*Rhus coriaria*), as Sicilian sumac of good average quality contains 26 to 28 per cent. of tannin.

Previous investigations of *Anogeissus latifolia* leaves were carried out by Fraymouth and Pilgrim (*Bulletin* No. 1, 1918, *Esociet Tannin Research Factory, Indian Munitions Board*). They recorded about 16 per cent. of tannin in samples of leaves and from 25 to 33 per cent. in various samples of "Dhawa sumac" (young leaves and twigs). In "Dhawa sumac" prepared entirely from red leaves they found 49 per cent. of tannin, and as much as 55 per cent. in prepared and sieved "Dhawa sumac."

The samples received at the Imperial Institute were also examined by Professor McCandlish and Mr. F. C. Thompson (Leather Industries Department, The University, Leeds) members of the Advisory Committee on Tanning Materials, who reported a high percentage of tannin in the leaves, similar to the results obtained at the Imperial Institute. They also conducted tanning trials with goat skins and obtained leather of very satisfactory character. The leather, however, proved rather sensitive to light when subjected to sensitivity tests with the mercury vapour lamp. The sensitiveness is greater than that of leather tanned with sumac, and in this respect *Anogeissus latifolia* leaves would be at a disadvantage in comparison with sumac.

Samples of the leather prepared at the Imperial Institute were submitted to firms in the light leather trade, who were favourably impressed and expressed a wish to try the material on a large scale.

CONCLUSIONS.

The Advisory Committee on Tanning Materials, having considered the results of the investigation and the information relative to the prospects of collecting the leaves on a commercial scale in India which had been furnished by the Forest Research Institute, Dehra Dun, expressed the following opinion :—

The leaves are very rich in tannin and generally of satisfactory composition. They promise to be a very useful tanning material, and would no doubt take a prominent place among tanstuffs for the light leather industry, but it would be unwise to consider the material as a rival to true sumac. With reference to the difficulties which have been experienced in India in drying large quantities of the leaves in the shade, involving the risk of fermentation and consequent loss of tannin, the Committee suggest that it would be desirable to investigate the possibility of employing sun-dried leaves. If leaves prepared in this manner prove to be of sufficiently satisfactory quality the difficulties of preparation should to a large extent be overcome. With this object in view the Committee recommended as the next step in the investigation that about 28 lbs. of sun-dried leaves should be prepared and forwarded to the Imperial Institute for further trials.

CLEAR-CUT FOREST POLICY.

MADRAS COUNCIL'S DEMAND.

By 40 votes against 31 the Madras Council carried to-day a token cut moved by Mr. C. E. Wood in the demand under Forests to discuss Government policy.

Non-official Europeans, who voted against Government *en bloc*, demanded a clear-cut policy regarding the exploitation and conservation of forests in the light of the recommendations of the Royal Commission on Agriculture.

Sir Krishnan Nair replying, maintained that the Government's forest policy served the best interests of the province and the Royal Commission's recommendations were being considered. The Government saw mills were not intended to compete with private enterprise and they were now closing down all saw mills.

(*The Pioneer.*)

VALUING THE ZOO.

THE RAREST ANIMALS.

At this time of year the Curators at the Zoo have the task of stock-taking and valuing the animals in the collection in preparation for the annual audit in February. Last year the collection was valued at £35,916 but only animals actually owned by the Society are included. Many valuable creatures, as for instance, the Komodo dragons, are on deposit and remain the property of private persons, though they will probably never be taken away.

Valuation is not easy except that of animals frequently imported and sold to private persons as well as to zoological gardens. Many mammals, birds, reptiles, and fishes have a market value more or less defined, varying for individual species with the sex, age, condition, and demand and supply. But there are fluctuations, sometimes unexpected. A few years ago blue budgerigars fetched as much as £100 a pair, and the prices of the common yellow and green varieties rose to several pounds; if the prices had been maintained the present stock in the Zoo's aviaries would now be worth several thousand pounds. But they have bred freely in many collections, and the blue ones are worth only one or two pounds, the others a few shillings a pair.

The purchase price is often not a safe guide to the present value even of animals which can be imported without much difficulty. Cape penguins and European flamingoes, for instance, could generally be imported for about £10 each, but many of them arrive infected with myxosis and do not live long. Those that survive six months or a year are hardy and likely to live almost indefinitely, and therefore have a greatly increased value. The commoner kinds of cranes and storks are hardy from the beginning

and live long; if undamaged they can be valued almost at cost price. Similar contrasts are found in the case of mammals. Young common seals when caught are worth little more than the cost of railway carriage, but are extremely difficult to get to feed and seldom thrive if forcibly fed. Once this stage is over they do well and increase in value. But Californian and Cape sea-lions are easy to manage and can be valued at cost price with allowance for size and sex, and possibly a drawback when an individual, as sometimes happens, is a persistent and clamorous roarer.

The price assigned to a creature too rare to have market value must be arbitrary. Rarity counts for something. The cost of maintenance has to be weighed—a walrus or an elephant seal consumes each several pounds-worth of fish daily, according to size.

Probably the Komodo dragons are the rarest creatures in the collection; their food is not unduly expensive; now that they have settled down and become tame there seems no reason why they should not live many years. They are great popular and scientific favourites. Possibly if they had to be valued they would be placed at the top of the list. The takin and the great echidna are the rarest mammals in the Zoo, most probably the rarest in any zoo; they are cheap to feed, but neither is a popular favourite, the former rather unaccountably, the latter because it remains hidden in its sleeping-box unless dragged out by a keeper. The takin is valued at £200, which some of its friends would think much too low. As the echidna is not the property of the Society no value has been assigned to it.

The prices given to some of the more familiar animals—which are, of course, not on sale—are as follows:—Indian elephants, £800; African elephants, £700; Indian rhinoceros, £1,000; African rhinoceros, £550; American bison, £80; European bison, £500; giraffe, £500; hippopotamus, £800; lions, £550; tigers, £100; thylacine, £100; and ayeaye, £40. The most highly valued birds are king penguins and wattled cranes at £75 and birds-of-paradise at £40.

(The Times.)

LAC INDUSTRY.

VALUABLE CROPS ON 'DHAK' TREES (*Butea frondosa*.)

The Director, Information Bureau, the Punjab, states as follows:—

A well-known landlord in the Ambala district while again invoking the assistance of the Entomologist to Government, Punjab, for lac cultivation on his estate has stated that in 1928-29 he obtained a lac crop worth Rs. 27,000 from his *dhak* (*Butea frondosa*) trees which were nothing but fuel previously. There is no reason why hundreds of other cultivators should not benefit to a similar extent if they take up lac cultivation. The Entomologist to Government, Punjab, Lyallpur, will give advice and help in the matter if requested.

(The Pioneer.)

INDIAN FORESTER

JUNE 1930.

THE SAL FORESTS OF HALDWANI, NORTH KHERI AND NEPAL.

BY E. A. SMYTHIES, I.F.S.

The finest sal forests in the United Provinces are found on the Bhabar terraces of Haldwani and the *damars* of North Kheri. Nepal borders Haldwani division on the east and North Kheri on the north, and both types of sal forest (on terraces and *damars*) are found in Nepal. I recently had the opportunity of seeing some of the Nepal forests, and the contrast between those forests and ours is most striking. As the primary conditions of growth (soil, drainage, climate and rainfall, etc.) are identical, it may be accepted that the contrast between our forests and the Nepal forests is due only to past and present management.

The essential differences in management may briefly be indicated. From time immemorial the Nepal forests have been burnt more or less regularly every year early in March or April. There are no restrictions regarding cattle-grazing, and herds of Tharu cattle and buffaloes wander at will wherever they wish. On the other hand there are relatively few deer in Nepal, since the Tharus and Nepalese hunt them freely day and night, and so do large numbers of tigers. Until recently, the more inaccessible Nepal forests have never been felled over and may therefore be regarded as virgin forests.

In our reserves, on the other hand, for the past half century at least there has been efficient fire-protection and protection from

cattle-grazing. Deer on the other hand (and especially sambhar) have increased enormously in numbers due to limitation of shooting, and reduction of poaching and of tigers. Our sal forests have also been intensively felled not only during the past 50 years, but particularly before forest protection started.

Thus in all essential points the management of our sal forests has been diametrically the opposite of the Nepal forests. Let us see the results.

The Haldwani terraces and North Kheri *damars* are almost everywhere densely stocked, with sal predominant in the upper canopy. In both divisions middle-aged poles and crops are very largely in excess, *i.e.*, crops 40 to 60 years old, but large mature trees still occur in fair quantity. In the virgin forests of Nepal, the first thing to impress the observer is how extremely open they are compared to our forests. A few enormous trees, a very occasional group of saplings or poles (so occasional as to be noted when seen), and that is all! Our forests, in addition to a dense upper storey of sal, frequently have a dense middle or lower storey of shade-bearing species, *Mallotus*, *Eugenia*, etc. In Nepal there is practically no middle storey of this type. Again, in our forests, there is a dense ground canopy of evergreen weeds and shrubs, so that progression on foot is difficult. In the Nepal forests this also is absent, and it is easy to walk everywhere on foot. In Bankatti Range of North Kheri where only a fire-line and a row of pillars separate our forests and the Nepal forests, the contrast between the two types is particularly impressive, and the *Nepal forests give us a vivid picture of what the Kheri forests must have been before reservation*. It is easy to understand why the revenue producing capacity of our forests has increased so enormously, and the contrast between the two sides of the fire-line is a splendid justification for the policy of forest protection.

There is, however, another side of the picture to be discussed.

Our dense forests obviously grew up immediately or very soon after fire-protection started. In North Kheri this is very evident, since fire-protection was introduced gradually over a 20-

year-period, and the dense evenaged pole crops of the earliest areas are just that much older than the young pole crops of the latest areas.

Now that we wish to regenerate some of these dense sal crops from seed, we find it practically impossible to do so. We have been trying for 10 to 18 years in parts of Haldwani, and have frankly failed. In the Nepal forests, the *sal regeneration everywhere is simply astounding*. There is no sal regeneration problem in Nepal, merely a few years of fire-protection would enable this vigorous regeneration to get through and develop into dense pole and sapling crops. The sal regeneration in Nepal is in fact comparable to the sal forest *chandars* of Pilibhit and South Kheri, but caused by fire instead of by frost and although mostly whippy shoots 3 ft. to 4 ft. high, is probably, half a century old.

The amazing difference between the sal regeneration in Nepal and the impossibility of regenerating our adjoining dense forests leads one furiously to think. The assumption underlying our management of these forests has always been that we can somehow or other get sal to regenerate naturally from seed, *but can we?* It was assumed that as sal forests had occupied the ground for centuries, there must be some way of regenerating them naturally. But has anyone ever succeeded in regenerating a *dense* sal forest naturally from seed? Certainly nowhere in the United Provinces, and I believe nowhere in Bengal.

Twenty years ago when I joined in the Ramnagar division with Sir Peter Clutterbuck as Divisional Forest Officer, he took me one day into the Bhandarpani block, and pointing to the dense masses of saplings, he mentioned that Sir Sainthill Eardley Wilmot years before had been censured for ruining this particular compartment! Some of the best stocked pole crops now in Gorakhpur are Amery's clear felled areas of 1880 and he was nearly dismissed for completely ruining them; and nowadays we try to regenerate dense sal crops from seed with fire-protection, with controlled burning, with shrub cutting, with seeding fellings, with deer proof fences, in brief with everything we can think of,

and we cannot point to a single compartment in the Province where we have succeeded. Is our regeneration policy all wrong, and is it necessary first to reduce a dense sal area to semi-ruin before it will regenerate? It looks rather like it.

But again, are we now too late? Have our dense fire-protected forests, with dense under canopy of evergreen weeds, shrubs and trees evolved a higher and utterly valueless type of flora with which sal seedlings cannot compete, and *which we can never eradicate*? I believe that some of the best of our *damar* areas are in considerable danger of this. In any case, suppose we deliberately set out to reduce a compartment or two of our best forests to the open, ruined, but completely regenerated condition of the Nepal forests, how long would it take to counteract half a century of protection? On this point we have a certain amount of evidence. We have burnt an experimental area in Haldwani annually for 10 years, under a complete sal canopy. The area certainly has more sal regeneration than in the surrounding forest, but the burning has only checked and not eradicated the evergreen invasion. In another and more open area of sal forest, annual early burning for 4 consecutive years has reduced the evergreen weeds from an almost impenetrable mass as high as an elephant to a dwarfed state where inspection on foot is easy. It has also increased the amount of sal regeneration appreciably, but at the same time has reverted it from 4 ft. and 5 ft. high to small whippy plants; (in this deer browsing has also had an appreciable effect). These results do, I think, suggest that for our best quality terrace and *damar* type of sal forest it may be necessary, 10, 20, or 30 years before regeneration is required, to open up the forests and burn annually or very frequently so as to try and bring back the conditions under which our existing forests started, and which are now to be seen in Nepal. But to duplicate the conditions exactly would also necessitate reducing the deer incidence. It is, however, a remarkable fact that where vigorous sal regeneration is abundant (*e.g.*, the Pilibhit forest *chandars*) deer browsing is negligible.

The study of the sal regeneration problem during the last 10 years or more has, I think, given us some concrete results.

For 10 years ago it was believed that manipulation of the canopy was the dominant factor in sal regeneration. But the problem is not so simple as that, and it is now realised that other factors are also important, notably evergreen weed competition, fire control and deer. There is little doubt that we can quickly and easily get up *woody* plants by giving plenty of light, protection from deer, and some assistance against competing weeds and shrubs. There is also little doubt we can get 1 year old seedlings in masses under suitable conditions, *i.e.*,

- (1) The ground must not already be occupied by evergreen undergrowth or heavy *ulla* grass.
- (2) Burning off the leaf litter before a big seed year.
- (3) Timely rain as the seed falls.

The results of the 1929 seed year where these three conditions were present have been very satisfactory and where any one of the three conditions was absent it has been disappointing. The problem of natural sal regeneration from seed in our terrace and *damar* forests therefore boils down to this; first to get the ground as free as possible of evergreen undergrowth (for seed germination), secondly to get the 1 year old seedling into the woody stage. Heavy shade and fire-protection will certainly not achieve the desired result. Heavy fellings over small seedlings and fire protection will also not achieve the desired result, as this has been tried and produced a crop of *Mallotus* and weeds which were already in vigorous occupation of the ground. Heavy shade and frequent burning will help to get small sal plants, but will not, I believe, ever get them to the woody stage. At any rate 10 years of burning under heavy shade has failed to produce woody shoots. The only combination left untried appears to be moderate to light shade with frequent burning (and if possible protection from deer)—which more or less represents the Nepal conditions. Whether such treatment will succeed in our forests now, and if so how long a period it will take, remains to be tested. One thing at least seems certain, that our past treatment of regeneration areas having so often failed must be wrong and we must change our tactics somehow.

To summarise the suggestions and conclusions of this note, which, I should like to emphasize, applies only to our well drained *good quality* sal forests on moist fertile loam, and not to hard clay soils or dry poor quality areas, or areas liable to be water-logged :—

(1) The present state of the Nepal forests gives us a picture of how our existing well stocked forests originated. They are in effect fire *chandars* under a shelterwood of large trees, with very little damage from browsing.

(2) Eliminate fire and browsing, and such areas will quickly produce dense sal sapling and pole crops. Continued fire-protection will introduce a dense evergreen undergrowth of weeds, shrubs, and shade-bearing trees.

(3) The natural regeneration *by seed* of such a dense forest is not possible with fire protection, and many of our finest and most mature sal areas are now in this impossible state.

(4) If we could again convert them to the state in which they originated—i.e., fire *chandars* under a shelterwood—their regeneration problem would possibly be solved. But whether, after half a century of fire-protection and deer-protection this is still possible, remains to be seen. And if it is still possible, how long it would take also remains to be seen.

From this it is evident that before the sal regeneration problem of our best and densest sal forests is solved, a number of important points still have to be tested on a practical scale, which will keep the Research Circle and Divisional Forest Officers busy for a long time yet.

SUPPLEMENTARY NOTE.

Since sending in the above article to the Editor, *Indian Forester*, for publication, I have received a very interesting letter from Mr. Bor, Working Plan Officer Kamrup, Assam, and as from his letter it appears that the revolutionary views which I have somewhat nervously expressed above were put forward by Mr. Milroy 10 years ago and *have proved successful*. I cannot refrain from quoting it.

Extracts from a letter, dated April 13th, 1930, from N. L. Bor, Esq., I.F.S., W.P.O., Kamrup, Assam, to E. A. Smythies, Esq., I.F.S., Conservator of Forests, Working Plans Circle, United Provinces.

"To those who live in thickly populated districts it may be surprising to know that we are still reserving forest land in Kamrup. This is all of one type, namely thatch land with numerous sal seedlings in the thatch. A few years fire-protection results in a sapling or pole forest. A sal forest never originates in any other way (my remarks only apply to Assam) and we believe that thatch is the only associate that sal will tolerate in its early growth. Annual burning is also a necessity. Pursuing the argument to its logical conclusion we say that if we can replace the undergrowth of our sal forests by thatch then sal seedlings will appear and survive. *Saccharum Narenga* and sal are light demanders; therefore open the canopy. Reproduce nature's methods as closely as possible, therefore burn. We know now that we can control the undergrowth of a sal forest by opening the canopy and burning. The effects of fire are cumulative and will eventually reduce the luxuriance of evergreen undergrowth without doing serious damage to the standing trees. When thatch appears the intensity of fire must be controlled by early burning. Milroy's plan for Kamrup prescribed cutting of subsidiary species and burning (early in thatch and late in other cases) while the forests were subjected to a series of improvement fellings. The results are astonishing. We have got thatch whenever we want it and regeneration is abundant when the thatch is present and the canopy open.

If there is one thing more certain than another it is the fact that sal will not come up under the shade of sal. We cannot expect to get thatch without opening the canopy; manipulation of canopy without burning will do no good.

The greater part of the sal is, according to the new plan, in the conversion to uniform Working Circle and P. B. I. is to be regenerated by groups and strips. Results are excellent so far. Thatch and seedlings are coming in and the whippy shoots are stimulated by annual burning to reach the fleshy stage.

The conversion period is taken as 100 years which allows 20 years for establishment. We consider this sufficient.

Summing up:—

1. Open out the canopy and don't be afraid of it. Cut subsidiary species.
2. Burn.
3. Cut back coppice of evergreen.
4. Let Nature do the rest.

This sounds idyllic and automatic but it really is not so. A very sound knowledge of local conditions is necessary to carry out the prescriptions.

Milroy wrote the Kamrup plan ten years ago and he has applied it personally during the period of the plan.

• • • • •

In conclusion, I would remark that any mention of the problem of the natural regeneration of sal in Assam would be incomplete without a reference to Milroy to whom must go all the credit for our success. His courageous plan for Kamrup of 10 years ago and his able application of it has completely altered our conceptions of the correct treatment of sal. I say courageous because his ideas were revolutionary and in conflict with the prevailing concept and they were condemned by his Conservator, and those in Bengal.

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Our experience goes to show that *under our conditions* burning is what sal likes and what is more a little rough treatment in reason and in the right place does it no harm."

CHAKRATA FOREST DIVISION.

BY G. M. HOPKINS, I.F.S.

1. *Situation.*—The Division lies in the north-west corner of the Dehra Dun District in a tract known as Jaunsar-Bawar. The headquarters of the Division, Chakrata, is a military station some 60 miles by motor road from the nearest railway station, Dehra Dun.

2. *History*.—Jaunsar-Bawar originally was included in Sirmoor (or Nahan) State. In 1807 it was taken by the Gorkhas, from whom the British took it in the war of 1815. Since then it has been under British rule and since 1825 has been in the Dehra Dun District. Forest Conservancy commenced in 1862, but no real progress in demarcation was made until 1869 and in 1875 the forests were reserved. Between 1917 and 1919 the forests were re-surveyed and a new settlement was made.

3. *Type of Country—Topography—Climate*.—The whole country is mountainous and very much cut up by innumerable ridges and valleys, the altitude varying from 1,500' to 10,000'. Roughly speaking, the division lies between the Tons and Jumna rivers. Great variations in climate occur. It becomes very hot in the lower valleys during the summer and heavy snow falls on the higher parts during the winter. The annual rainfall in Chakrata itself is about 71".

4. *Geology*.—The geology of the tract is so complicated that even the experts of the Geological Survey have not yet arrived at any definite conclusions on the subject. The strata are mostly still designated by local names. The geology does not affect the management of the forests to any great extent except where clayey sub-soils prevent chir (*Pinus longifolia*) regeneration and where quartzite in the deodar (*Cedrus Deodara*) areas result in very poor quality crops.

5. *Forest Roads—Supplies, etc.*—There are no motor or cart roads beyond Chakrata but the tract is well supplied with good mule roads, besides innumerable footpaths. The main road is called the Upper Simla Road and connects Simla with Mussoorie. Apart from rice and potatoes all supplies for the labour working in the forests is imported from the plains.

6. *Flora, etc.*—The forests may conveniently be divided into four main zones of vegetation:—

(a) *The Sub-Tropical or Sal Kokat Zone upto about 3000' altitude* containing inferior sal (*Shorea robusta*) and its usual associates.

(b) *The Temperate or Chir Zone from 3000' to 6000' altitude.* The main species is chir (*Pinus longifolia*) associated with hill tun (*Cedrela serrata*), ban oak (*Quercus incana*), burans (*Rhododendron arboreum*), and ayar (*Pieris ovalifolia*). In the higher parts kail (*Pinus excelsa*) often appears.

(c) *The Sub-Alpine or Deodar Zone from 6500' to 9000'.—* The main species is deodar (*Cedrus Deodara*) associated with kail (*Pinus excelsa*) and in the higher parts spruce (*Picea Morinda*) silver fir (*Abies Pindrow*) and moru (*Quercus dilatata*).

(d) *The Alpine Zone above 9000'.* Containing kharshu (*Quercus semecarpifolia*) spruce, fir, etc.

7. System of management.—

(a) The spruce, fir and oak forests and also all areas throughout the division in which the tree crop is insufficiently dense to make exploitation profitable are treated under a system of simple protection. The reason is that the above species cannot be profitably utilized. An exception to this is a small area of spruce, fir and oak which is exploited to meet the demands from the military for fuel in Chakrata.

(b) The deodar and kail forests are worked under a periodic block system with regeneration by compartments. At present over 100 acres are being planted annually with deodar nursery plants.

(c) The chir forests are in the process of conversion from irregular to regular forests with regeneration by compartments.

8. *Produce extracted, etc.*—Apart from the fuel supplied to the Chakrata troops the whole outturn is in the form of sawn timber. Labour imported from neighbouring States carries out every operation. After felling the trees and sawing them up in the forest, the timber is carried by coolies to the nearest small stream. After collection there it is conveyed either to the Tons river or to the Jumna river by telescopic floating, and is floated down these rivers to a boom across the river at Dakpathar at the foot of the hills a few miles below the junction of the Tons and Jumna rivers. After being caught and taken out of the river at Dakpathar it is made into rafts and rafted down by river and canal

to Jagadhri on the North Western Railway, which place is on the main line between Saharanpur and Ambala. The timber is sold there and, except for sleeper supplies to the East Indian Railway, is practically all exported to other parts of the Punjab.

Minor products are of no importance though a few herbs and medicinal roots are occasionally sold. Forest industries do not exist.

9. *Habits, etc., of local population.*—The country is sparsely populated and the population is largely self-supporting. Jaunsaris are notoriously lazy and are very fond of holding festivals during which they consume quantities of home-brewed liquor and spend much time in dancing. Polyandry is extensively practised.

The people are excessively well treated in the way of rights and concessions in the reserved forests, but do not consider this any reason why they should give the slightest help to the Forest Department.

10. *Shikar and Fishing.*—There is no sporting fishing in the Tons river as the water is too cold, but at certain times of the year heavy catches of mahseer may be made in the Jumna.

Owing to innumerable unlicensed guns and the lack of any efficient police and shooting guard system poaching is rife. Big game, except black bears, is extraordinarily scarce and appears to be getting scarcer each year. Pheasant and partridge shooting is quite good in the autumn.

**SHISHAM DEFOLIATOR IN KHANEWAL
PLANTATION.**

**BY RAM NATH KASHYAP, P.F.S. AND MANOHAR LAL
MATTU, P.F.S.**

The shisham defoliator (*Plecoptera reflexa* Guen.) made its first appearance in Khanewal plantation in 1918, a year after the plantation was actually started. Since then it has been

appearing regularly reducing the crop completely leafless for several months in the year. The following observations have been made:—

1.—PERIOD OF ATTACK.

From the meagre past record available it appears that the defoliator becomes active with the commencement of summer, the attack being visible in the months of May and June, when the first defoliation is complete. The attack continues till September except under favourable conditions when it terminates in August. This year (1929) the attack commenced in the last week of June and now the plantation is free from the defoliator. The causes of this unusualness are discussed below.

2.—THE INTENSITY OF ATTACK.

It is an established fact that the life cycle of the insect is completed within a fortnight. As a general rule complete defoliation of the plantation takes place thrice every year in the period mentioned above. New leaves come out where they have been defoliated and are again eaten up. This process goes on from the start to September, when probably the hibernation period of the insect begins.* The caterpillar shows a predilection for the tender leaves, but when tender leaves are not available, it eats up the tougher leaves also. This year the attack was confined to about a quarter of the area, and was very much milder, only the weak and backward crops suffered. The factors which govern the intensity of attack are:—

- (a) *Rainfall*.—From the past records it is noticed that in the years of scanty rainfall (1920-21 1923-24, 1924-25), *i.e.*, when only a few showers of rain fell in July or August, the attack was not affected at all. But in years of comparatively heavy rainfall (1925-26) when 7·12" of rain was recorded, the attack ceased in the month of August. This year again 8·09" of rain has been recorded in July alone, and in August the plantation was almost completely

* The Forest Entomologist informs us that the defoliator has 9 generations between April and October and a possibility of 13 per annum. [Hos. Ed.]

in leaf. Apparently the eggs have been washed away from the leaves, and the caterpillars killed with excess of water.

- (b) *Irrigation*—(i) The usual period of irrigation is from the 1st of April to 15th of October. This year (1929) the actual irrigation started on the 23rd of April. The late commencement of the attack this year suggests some connection with the start of irrigation. But in 1923 also the irrigation started as late as May, but it is not recorded that the attack was correspondingly delayed. It is just possible that the early irrigation provides new and tender leaves for the first brood of the insect, the date of whose activity synchronises with the start of irrigation.
- (ii) There is no doubt that the weak and backward crops are more liable to attack than the vigorous stems. This statement is fully borne out by the fact that the plantation which has been rendered completely leafless in the past since its very inception, has been getting varying quantities of water, *viz.*, from 1916 to 1920 a depth of 3 feet only was given, which was raised to 3'5" in 1921, and further raised to 4'5" in 1926, since when the latter quantity is being given every year. In the past the plantation on the whole was merely struggling between life and death, but with the increased supply of water the condition of the crop is much healthier. It is possible that the restricted nature of attack this year is due to this fact.
- (c) *Thinnings*.—Without dispute thinnings tend to improve the crop, by better circulation of air, etc., and consequent increased vitality. This fact in itself should reduce the intensity of the attack as has been noticed in about 600 acres thinned in the cold weather of 1928-29. But it has also been

noticed that the attack was mainly confined to the coppice shoots which appeared on the stools of trees cut, and were about 3 to 4 feet high. It has been observed that the coppice shoots which provide a crop of tender leaves for the caterpillar to eat, reduce greatly the damage to the main crop by keeping the insect busy in the lower canopy. The attack spreads to the upper canopy only after the complete defoliation of the coppice leaves.

3.—CONCLUSIONS.

- (a) A good rainfall washes down the insects and stops the attack.
 - (b) The comparatively milder attack of 1929 can mainly be attributed to the better health of the trees which is now obtainable in the plantation due to better irrigation now being given since 1926.
 - (c) The intensity of attack can be mitigated considerably by keeping the crop properly thinned, which invigorates the main crop and provides coppice shoots for the food of the insect in the shape of new and tender leaves.
 - (d) Weak and backward crops are the most readily attacked by the insect.
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**NOTES ON THE ESTABLISHMENT OF ALEURITES
FORDII (TUNG OIL) IN THE RANCHI DISTRICT
OF CHOTA NAGPUR.**

BY DOROTHY NORRIS, M.Sc., A.I.C., AND H. T. BATES.

The question of the cultivation of *Aleurites Fordii*, family *Euphorbiaceae*, in India is not new, as this plant has been grown to seed at the Forest Research Institute, Dehra Dun, United Provinces.

It was suggested by the Director, Royal Botanic Gardens, Kew, England, that experiments on the growth of *tung* oil trees

might also be carried out in other districts in India and seed was accordingly sent to the Director, Indian Lac Research Institute, Ranchi, Bihar and Orissa.

Ranchi is situated on the Chota Nagpur plateau at an elevation of approximately 2000 feet. The soil is chiefly red laterite with considerable rock outcrop, and varies from a loamy clay to a clayey loam. The following are two analyses of soil taken from places 18 miles apart:—

I.

<i>Chemical.</i>		<i>Mechanical.</i>	
Moisture	... 1.46%	Moisture	... 1.46%
Organic matter	... 1.60%	Soluble in dilute acid	... 0.88%
Total nitrogen	... 0.06%	Coarse sand	... 31.12%
Total phosphoric acid	0.20%	Fine sand	... 39.71%
Total potash	... 0.25%	Silt	... 12.42%
Total lime	... 0.14%	Fine silt and clay	14.41%

Acidity (parts CaO per million) 336 parts.

II.

<i>Chemical.</i>		<i>Mechanical.</i>	
Organic matter	... 1.946%	Coarse sand	... 32.45%
Insoluble matter	... 92.16%	Fine sand	... 42.4%
Lime CaO	... 0.09%	Silt	... 15.3%
Magnesia MgO	... 0.15%	Clay	... 1.5%
Total phosphoric acid	... 0.0256%	Moisture	... 0.59%
Total potash	... 0.031%		
Soda Na ₂ O	... 0.15%		
Sulphuric acid SO ₃	Trace.		
Carbonic acid CO ₂	Nil		
Alumina Al ₂ O ₃	... 4.26%		
Oxide of iron Fe ₂ O ₃	1.12%		
Total Nitrogen	... 0.04%		
Available potash	0.012%		
Available phosphoric acid	... 0.0008%		

From the above figures it is obvious, therefore, that the soil cannot be considered particularly fertile as it is deficient in the main requirements of plant food and it is, therefore, necessary to make use of fertilisers when endeavouring to grow crops of any kind.

The climate is typical of that of the central parts of north India and consists of three distinct seasons viz., the winter or cold season from November to February, the dry or hot season from March to mid June and the rains from mid June to the end of September.

During the cold weather the rainfall consists only of showers at long intervals. Frost occurs at night during December and January, as much as seven degrees having been registered on the ground, usually however the amount is only one or two degrees. The hot season starting about the middle of March is exceedingly severe on plant growth. Maximum shade temperatures of 110 degrees are not uncommon and these are usually accompanied by a strong scorching wind from the North-West which blows from sunrise to sunset. Humidity during the day is often as low as 10 per cent. Rainfall during this period varies from year to year, but droughts of 60 to 70 days are not unknown.

The climate during the rains is controlled by the South-West monsoon and the annual rainfall varies from 50 to 75 inches with a fair average of 62 inches. At least 55 inches fall between the months of June and October so that the general distribution is bad.

The seed of *Aleurites Fordii* sent from Kew arrived in its original shell but the amount was too small to make a test of sound seed on arrival. It would, however, appear that the percentage of this was high and that the seed had suffered little, if any deterioration, in transit. The fruit contained from three to five seeds each. Half the seed was sent to the Manager, Sabaya Tea Estate, eighteen miles from Ranchi and half was utilised at Namkum, Ranchi.

Sabaya.—At Sabaya these were planted in shaded nursery beds in May 1928 in rows two feet apart, the distance between

seeds being one foot, which appears to be quite satisfactory. Germination was noticed in 32 days and the first plant appeared above ground on the 46th day. Out of 96 seeds sown 74 produced plants giving a germination figure of 77 per cent. Artificial watering was given until the break of the monsoon. The plants grew very rapidly and by August some had attained a height of eighteen inches. Transplanting was commenced in August in good weather conditions.

The plot selected for the plantation was a piece of waste land, generally similar to the nursery one, this was cleared of undergrowth only. Holes 3 feet square and 3 feet deep were made at a distance of 30 feet by 30 feet square planting, and these were filled with a mixture of half cowdung manure, and half of the excavated soil, and in this the plants from the nursery were set out. Plants were lifted from the nursery beds complete with a large ball of earth so that the roots were not disturbed in any way, this method of transplanting is however rather expensive but in view of the small number of plants available for experiment it was decided not to risk carrot transplanting.

The spacing distance of 30' \times 30' was, after the plot was completely filled, considered to be too great, so an extra plant was placed at the crossing of the X and this arrangement allows ample light and air for the trees. After planting each tree was protected with a bamboo gabion in order to minimise damage from cattle, in the case of a fenced plot this would be unnecessary. The plot was fenced in March 1929, and the gabions removed. The removal of the gabions exposed the plants to a hot scorching wind, but in spite of this they stood up very well to the very trying conditions then prevailing, and leaf scorch was only noticeable on the lower or older leaves. Artificial watering had to be resorted to, and the plants received about one gallon of water each daily throughout April and May. It may be recorded however that 1929 experienced by far the most severe hot weather for the last 14 years, and it may be said, therefore, that the *tung* oil plant must be hardy to have withstood the extremely trying conditions to which it was subjected. On May 13th, 1929, an application of 1lb. of fish waste manure was forked in round each

tree, but no other cultivation of any kind was given. Fish waste was used as a manure not for any special reason, but because it was on hand at the time.

Recorded growth measurements were started on June 11th, 1929, and the rate of growth on four selected trees is given below all the trees were 15 months old at the commencement of measurement.

			Tree No. 1.		Tree No. 2.		Tree No. 3.		Tree No. 4.	
			ft.	in.	ft.	in.	ft.	in.	ft.	in.
June 17th	...	...	5	6	3	6	4	11	3	5
" 24th	...	...	5	8	3	8	5	0	3	6
July 1st	...	...	5	11	3	9	5	1	3	6
" 8th	...	...	6	2	4	0	5	2	3	6
" 15th	...	...	6	6	4	3	5	3	3	7
" 22nd	...	...	6	9	4	3	5	5	3	8
" 29th	...	...	7	1	5	0	5	5	3	10
August 5th	...	...	7	3	5	5	5	5	3	11
" 12th	...	...	7	5	5	6	5	5	3	11
" 19th	...	...	7	6	5	9	5	5	3	11
" 26th	...	...	7	9	6	0	5	5	3	11
September 2nd	...	...	7	10	6	1	5	6	3	11
" 9th	...	...	7	11	6	2	5	6	3	11
" 16th	...	...	7	11	6	2	5	8	3	11
" 23rd	...	...	8	0	6	2	5	9	3	11
" 30th	...	...	8	0	6	2	5	9	3	11
October 7th	...	...	8	0	6	2	5	9	3	11
" 14th	...	...	8	0	6	2	5	9	3	11

Tree No. 1, *vide* photograph, was of a single stem without side branches, and was at the time when measurements



Tree No. 1, age 14 months



Tree No. 2, age 14 months.



Tree No. 3, age 14 months.

started the tallest tree in the plot. Lateral branches made their appearance at a height of 6 ft. 2 in. on July 8th.

Tree No. 2, *vide* photograph, had already thrown out considerable lateral branch growth early in the year and was a sturdy robust type of tree.

Tree No. 3 was similar to No. 2 but somewhat larger.

Tree No. 4 was a tree with lateral branch growth similar to No. 2.

Weekly measurements were taken and these show a decided variation. It would appear however that plants grow very rapidly until they set lateral branches, when growth slows down. The production of lateral shoots is also very irregular, some plants putting these out at a very early age. Usually three to four shoots are put out at the start, and these grow in an upward direction at an angle of about 45 degrees to the main stem. Local soil conditions may also account for the difference in the rate of growth, but it is difficult to say at this stage what are the controlling factors. It can definitely be said however that given reasonably good conditions *Aleurites Fordii* is a very rapid grower. The plant appears to have a definite growing season, growth entirely ceasing in mid September after which the tree sheds its leaves and remains dormant until the following March when the new leaf flush appears.

The measurements given in the table above were all taken on the main stem, and Tree No. 4 which appears to have made very little progress has thrown out branches which over-top this stem considerably.

The plot at present being reported on is rather uneven in growth as previously mentioned and all plants under average normal size received special treatment in the way of manuring in order to try and even up the plot and definitely decide whether poor soil was responsible for their failure to keep up with the larger plants.

The experiment has been carried out under as natural conditions as possible and cultivation has only consisted of keeping a circle of soil round the base of the plant free of weeds and jungle,

the intervening land has been left under grass and no attempt made to cultivate the entire plot.

In July, 1929, the plot was given a manurial application of concentrated superphosphate at the rate of 1lb. per tree with a view to establishing the plants sufficiently to withstand the next hot season without the necessity of resorting to artificial watering.

One point which has been observed is the fact that the *tung* oil tree definitely dislikes shade.

Two lines of trees in the plot under report are adjacent to heavy shade trees and the difference in growth between these two rows and those in the open is most noticeable, the shaded rows being stunted in growth and sickly. It was at first thought possible that the difference might be due to interference from the root growth of the shade trees and so a drain 3 feet deep was cut up the whole length of the plot in order to obviate this factor.

This, however, has had no effect and it would appear therefore that the shade alone is the main factor.

Since the last report two other plots have been planted out and the transplants have all done exceedingly well, the areas selected being free from shade.

One plant aged 18 months from seed, set one seed, but unfortunately this did not mature. No signs of flowering have been noted on any of the others.

Since the commencement of the experiment three plants have died at Sabaya from what appeared to be some form of root disease as on digging out the roots were found covered with a white fungus. New plants filled in their places are so far growing well.

Namkum.—The seeds were sown here in unshaded beds, one lot on the 25th and 26th June, 1928, and a second lot on 5th July, 1928. The distances being the same as at Sabaya.

Rain followed fairly soon after sowing and hence very little artificial watering was necessary.

Germination commenced about thirty days from sowing, the percentage being 45. It was, however, observed that some of the seeds which had escaped germination at this time sprouted at the end of the next cold weather.

With a further consignment of seed received in 1929 seeds were sown on 15th March, 1929, germination commenced in 32 days, the percentage in this case being 94.

These figures would indicate that the end of the cold weather is a better time for sowing than at the outset of the monsoon.

When the seedlings of the June and July 1928 sowings reached a height of 8"—10" they were transplanted to a neighbouring area free from shade in two batches—the first on September 17th, 1928, and the second on November 10th, 1928. Planting was done at 20 feet triangular spacing in pits 1½ ft. deep.

The ground had previously received lime at the rate of 1,000 lb. per acre and subsequent to transplantation each plant received ½ lb. of concentrated superphosphate and ½ oz. of ammonium sulphate.

The whole plot was kept under cultivation by ploughing and harrowing and in comparison with the trials at Sabaya it would appear that this results in much healthier plants during the earlier stages as the entire area shows remarkably even growth.

No gabions were used as the plot was in a fenced area.

Artificial watering was given every other day when necessary.

White ants attacked the plants during the hot weather of 1929 and therefore a manuring with *karanj* cake (*Pongamia glabra*) was given at the rate of ½ lb. per tree.

It was noticed, as at Sabaya, that little growth took place during the cold weather. Measurements taken in May, 1929, on the 1928 transplants showed that some had attained a height of 3½ feet.

The following are growth records of four plants starting at the age of twelve months.

	26th June, 1929.	3rd July, 1929.	11th July, 1929.	24th July, 1929.	7th August, 1929.	21st August, 1929.	5th September, 1929.	21st September, 1929.
Tree No. 1 Height	...	5'	5'-2"	5'-3"	5'-10'	6'	6'	6'
Branch spread	...	2'-2"	2'-5"	3'-8"	4'	4'-7"	4'-10"	4'-10"
Number of branches	...	7	9	9	10	10	10	10
Tree No. 2 Height	...	4'	4'	4'	4'	4'	4'	4'-2"
Branch spread	...	3'-2"	3'-5"	3'-10"	4'	4'-6"	4'-9"	6'
Number of branches	...	15	15	15	15	15	17	18
Tree No. 3 Height	...	4'	4'-4"	4'-8'	4'-8'	5'-10"	6'	6'
Branch spread	...	1-9½'	2'	2'-3"	3'	3'-4"	3'-6'	4'-4'
Number of branches	...	15	15	15	15	8	8	8
Tree No. 4 Height	...	3'-2"	3'-4'	3'-6"	3'-7"	3'-7"	3'-7"	3'-7"
Branch spread	...	2'	2'-6"	2'-7"	3'-2"	3'-2"	3'-2"	3'-2"
Number of branches	...	8	8	9	9	9	11	11

The above report deals entirely with seed received from Kew, England.

Results from seeds distributed by the Forest Botanist, Dehra Dun, have not been so encouraging, germination being only about 30%

No results have so far been obtained from *Aleurites montana*, seed of this variety being received in May 1929. Tests on this are still proceeding.

A single trial of *tung* oil as a lac host gave negative results (July—October season). These experiments are being continued as two scale insect pests are reported from Florida.

APPENDIX.

Cost of establishing 69 *Tung* Oil Plants from seeds at Sabaya Tea Estate from May 1928 to December 1928.

	Rs.	a.	p.
Making nursery and planting seed	...	3	15 0
Transplanting (including cost of making pits)	...	27	1 0
Labour applying manure	...	0	13 9
Cost of manure	...	1	13 0
Cultivation	...	3	8 9
Watering	...	5	14 0
Total	...	43	1 6

This does not include cost of gabions Rs. 17-1-0 and fencing Rs. 13-7-0. It does however include charges on another 48 plants still in the nursery.

Cost of establishing 105 trees at Namkum, June 1928—March 1929, worked out as above, amounted to Rs. 43-13-3.

These figures would, therefore, give a rough estimate for putting out a plantation of moderate size, of about Re. 0-8-0 per plant to the end of the first year. This figure is exclusive of any fencing required.

CAPTURE AND TRAINING OF ELEPHANTS BY THE MADRAS FOREST DEPARTMENT IN SOUTH MALABAR.

BY R. S. BROWNE, I.F.S.

1. *General*.—The method of capturing and training elephants in South Malabar is that generally adopted in other parts of the Madras Presidency, where such operations are undertaken, though minor details may differ slightly.

2. *Pits*.—The pitfall method of capturing is invariably employed. Injuries to the animals are almost entirely eliminated if this method is practised with care. The pits are located along known elephant tracks. A common arrangement is 3 pits in echelon, the centre pit being on or very near the actual track. Or the track may be blocked by felling a large tree across it, and the pits arranged so as to catch the elephants when they make a detour to avoid the obstacle. An interval of about 20 feet is required between pits to allow tame elephants and men to move freely during capturing operations. There should be a few big trees near the pits to which ropes can be fastened. The pits are 12 feet square at the top, 9 feet square at the bottom, and about 10 feet deep, and must be free from projecting boulders. The sloping sides tend to break the force of the fall, but the most important precaution against injury lies in the "padding" at the bottom of the pit. This consists of bundles of grass and brushwood, to a depth of at least 4 feet. The padding must be renewed frequently since it sinks down, and is also liable to attack by white ants. The excavated earth must be concealed at some distance from the pits. The pits are covered in such a way as to resemble the surrounding ground. In South Malabar, most of the trees are leafless in the capturing season, and concealment of the pits, by dead leaves over a framework of split bamboos, is an easy matter.

3. *Watching the pits*.—Pitfalls generally take place at night, but are possible during the day as well. Watchers go round all the pits early every morning, and again during the day, if there is a herd in the vicinity. The watchers look to the covering and the padding of the pits, and do such renewals as are necessary.

They send information of a fall, without delay, to the officer in charge of capturing.

4. *Capturing*.—As soon as information is received, the officer or subordinate responsible, hastens to the spot with the decoy elephants, a gang of coolies, and the necessary ropes. Three to five tame elephants are used, according to the size of the animal to be captured. The ropes may be either of hemp or of freshly cut and twisted fibre such as *Sterculia*. Two such ropes are required. They are about 75 feet long, and about 3 inches in diameter, tapering to one end. There is a loop at the thick end for forming a noose. As soon as the capturing party reaches the pit, coolies commence to cut and collect wooden billets and brushwood, with which to fill the pit. Adjacent pits should be uncovered, to prevent accidents. The tame elephants stand round the pit, and noosing commences. The neck of the fallen elephant is noosed first. His height (at the withers) is measured as accurately as he will permit. Seven Eights of this measurement is then marked off on the rope from the loop and a wooden peg is inserted through the diameter of the rope at this mark, and is bound so that it cannot move. (This precaution is to prevent the noose tightening to such extent as to strangle the elephant). The thin end of the rope is then passed through the loop, and a wide noose formed. The wide noose is then held over the pit by means of forked sticks, and is dropped over the animal's head when an opportunity presents itself, and is tightened quickly, as soon as it falls on the shoulders. This operation usually requires a lot of patience, as the elephant fights against the rope all the time. By worrying him with a handkerchief on the end of a stick, he is made to raise his trunk so as to seize the offending flag, thus offering the most favourable position for dropping the noose. When the noose has been tightened as far as the wooden peg, it is made secure by binding it at the peg with thin rope, keeping the noosed animal close to the side of the pit, as far as possible, while doing so. One of the hind legs is then noosed, below the knee. An open noose is let into the pit, using forked sticks. The animal is made to raise his foot by prodding it with sticks, and the

noose is manœuvred underneath, and pulled taut. (This, also, is usually a slow business.) No protecting peg is required on the leg rope. The noosed leg is raised by pulling on the rope and the noose is secured by means of a thin rope, tied and twisted round the leg and the noose. (Sticks are used to help in this tying.) Two neck ropes may be required if the animal is very big. As soon as the ropes are tightened, the free ends are fastened to trees by a couple of turns, so that they can be quickly tightened or loosened as required. A supply of water is kept at the pit, and is poured over the elephant at intervals during the operations, to prevent exhaustion. When both neck and leg are secured, the pit is filled up by throwing in billets and brushwood, concentrating on the corner where the animal's fore-feet are. As soon as this filling has reached a sufficient height the elephant climbs out. The ropes are tightened, and the decoy elephants close up, to prevent the capture escaping. The neck rope is unfastened from its tree, and secured round the body of one of the decoys. The leg rope is then similarly fastened to another decoy. The decoys keep close up to the new capture, taking the slack of the ropes in their mouths if necessary. The third tame elephant takes up his position opposite the decoy on the neck rope. Any further securing of the ropes that is required, is easily done at this stage, and the third decoy can be given a rope to hold in his mouth, if necessary. The capture is then marched off into captivity.

5. *Enkraaling*.—The first weeks or months (depending on the age of the captive) after capture are spent in a massive wooden kraal, about 12 feet square, and 12 feet high, with a thatched roof. The flooring is of wooden planks, which should have sufficient space between them to allow of thorough disinfecting. The floor is raised about 2 feet above ground. The space beneath the floor is paved, and faced with cement, on a slight slope to facilitate cleaning, and cement drains carry off urine, water, etc. Cleanliness and disinfecting of the kraal and its surroundings are most important. The sides of the kraal consist of strong horizontal wooden rails, about 18" apart, which pass through holes cut in the wooden pillars. A wooden ramp gives

access to the raised floor of the kraal. To receive the captive the side rails are pulled to one side, through the holes in the pillars, leaving sufficient space between the two pillars next to the ramp for the elephant to enter. On arrival at the kraal, the neck-rope is unfastened from the front decoy, and is passed through to the opposite side of the kraal, where it is held by a gang of coolies, who pull as required. The rear decoy pushes the captive from behind, and the capture is thus completed. The rails are pushed back into place, and are secured with wedges. The ropes are then removed.

6. *Taming*.—As soon as an elephant is captured, a driver (mahout) and an attendant (cavady) are appointed. One or other should stay beside the kraal, day and night, until the animal becomes quiet. These men are entirely responsible for the care and training of the elephant (under supervision) and it is most undesirable to replace them by others. The elephant quickly gets to know them. Once in the kraal the captive is kept well supplied with cut fodder and water. The water is kept in a wooden trough outside the rails, within easy reach of the elephant's trunk. For the first week, the work of the attendants consists in keeping their elephant supplied with food and drink, keeping the kraal clean, and tending any cuts and abrasions that have occurred during the capturing and the first restless days in the kraal. Such wounds are washed with disinfectant, by means of a swab on the end of a stick, and are rubbed with carbolic oil in the same manner. Washing the elephant's body is restricted, at this period, to throwing water over him. But the elephant helps by spraying himself with water from his trunk. From the day of enkraaling the elephant is made accustomed to the presence of his attendants close to him, and to the sound of their voices. In these early days, too, the elephant is taught to allow himself to be touched by men; this is taught, in the first instance, by gently rubbing his body with a sort of brush, on the end of a pole. His attendants occasionally give him pieces of sugar-cane, which are very welcome. After about a week from the time of capture, his taming is carried a stage further. Each morning and evening he is confined in about half the space of the kraal, by putting stout

poles across, and tying them to the railings and pillars. The attendants then enter the vacant half, and train the elephant to allow himself to be rubbed by hand, rewarding him with sugar-cane or jaggery when he acquiesces. At this stage the attendants are able to give him a reasonably good bath, being at close quarters. When the elephant has been thoroughly accustomed to this kind of handling, and has lost his earlier suspicion of his attendants, it is no longer necessary to confine him for training in the reduced space. The attendants go into the kraal with the elephant—with great caution at first. From now onwards the elephant is really well washed, and his training proper begins. He is put through a regular drill, each morning and evening. Kindness is the secret of success. Beating is rarely necessary, and must be avoided as far as possible. The elephant is kept at one lesson until he has learnt it thoroughly, before proceeding with the next. The action he is required to take is indicated by pointing with a stick, by tapping his body, trunk, or legs with a stick so that he moves as required, etc. The word of command for each action is repeated quickly, all the time, so that he comes to associate each drill movement with its verbal order. When he assumes the required position, the repetition of the order is stopped and he is patted on the trunk, and further made to understand, by soothing sounds, that he has carried out the order correctly. He is also encouraged, by occasional lumps of jaggery, to learn his lessons. In this way the elephant is taught to turn right, turn left, walk forward, halt, walk backward, lie down (as for loading baggage), raise the trunk, pick up with the trunk, raise the fore-leg, raise the hind leg, etc. During this period, too, his diet of cut fodder is required, and is partially replaced by balls of cooked rice. While in the kraal, he is also made accustomed to chains on his legs, *i.e.*, the hobbles and the trailing chains. When he has learnt to obey simple words of command, he is taken out of kraal daily, for exercise, grazing, and washing in the river. For about a week he will be taken out, tied to a tame elephant by a neck rope. Thereafter he can usually be taken out by the attendants without assistance. For several weeks he is brought back to the kraal each night. Later, he is left out at night to graze in

the forests, with his fore-legs hobbled, as in the case of fully trained elephants, and is brought back in the morning to be washed and fed. The rapidity of the training depends largely on the age of the elephants, the younger ones being quicker to learn and more docile than older animals. Hobbles should always be fastened when a new capture is grazing, whether by day or night. The stage at which hobbles are not required, when the elephant is taken out under the direct control of his attendants, depends on the degree to which his training has advanced. Ordinary training, as apart from training for work, takes about 3 months in the case of animals 10 years old and less, and up to 6 months for older elephants. Provided this training is carefully done, the education of the elephant for work (carrying baggage, dragging logs, pushing and lifting logs, etc.) is only a matter of practice and offers no difficulty.

PRIZE-DAY AT THE FOREST COLLEGE, DEHRA DUN.

The annual prize-giving at the Ranger College, Dehra Dun was held on 29th March, 1930.

The Inspector General of Forests made the following speech:—

“This is the sixth prize-day at the Rangers College at which I have had the pleasure of presiding, and I think you will agree with me that it is always a pleasant function, and that the Rangers College is one of the most picturesque spots in Dehra Dun. Since we took over this estate more than 50 years ago we have had 49 distributions of prizes at the Rangers College, and have trained, and given certificates to, 1,464 Ranger students. Many of these Rangers are still working in India and Burma, and a considerable number have been promoted to the Provincial and Imperial Services. I am glad to say that we can remember the class now leaving as being exceptionally good, as two students have obtained Honours—no Honours certificates having been earned since 1927. I have again great pleasure in noting how well the Kashmir students have done, both the Honours certifi-

cates and 3 of the 19 Higher Standard certificates going to that State. Kashmir for the third year in succession has produced the best students of the year. The total number in the class was originally 27, and the students who have completed the course have obtained two Honours certificates, nineteen higher standard and two lower standard certificates. The re-introduction of the entrance examination has raised the average standard of the classes, but the qualifications which the students bring are still, in a number of cases, insufficient to allow them to profit fully from the technical instruction given. The 1928—30 class was, on the whole, somewhat better than the average of the past five years. There is a point here which I wish to mention, not particularly pleasant, and that is, that we regard attempts to bring influence to bear on behalf of students with the greatest displeasure. It has been necessary for me at various times to dismiss students, to award lower standard instead of higher standard certificates and to refuse, very regretfully, to give any certificate at all. In many of these cases I have been approached by relations and friends to modify my orders, and I must warn all students at the College that these methods will always do harm, and not good, to the students concerned.

In physical efficiency, games, athletics, and ability to stand long days in the forest, the outgoing class is well above the average of past years. In games and athletics the Punjab students were the mainstay of the class. They took most of the prizes at the athletic sports, Ghazanfar Ali winning the Inspector General's cup for athletics in 1929, as he did in 1928.

The College Marathon, a 7-mile cross country race, was won by Ghazanfar Ali in 47 minutes 19 seconds, Atta Elahi being a close second. Atta Elahi's time of 47 minutes in 1928 is the College record for this event.

In games we were somewhat handicapped by there being only one class in residence during the rains term. Hockey continued to be the favourite game and our team was one of the best in the station. At football and cricket we were not so good, and a series of casualties to staff and students brought football to an

early close. In games the outstanding students were Alam Singh of the United Provinces and Atta Elahi of the Punjab.

The health of the class was very good throughout the year, and there was no case of serious injury or illness.

In the first year the class toured in the Dun, doing surveys, road alignment, and practical silviculture. In the second year the class did practical forestry in the Chakrata Division, stock mapping in Saharanpur, and a general tour in Pilibhit, Haldwani and Ramnagar Divisions. As usual the Divisional staff was most helpful.

With the passing out of the present senior class the change in the College year will be completed. There will be only one class in residence from April till October this year, and hereafter the College year will commence on the 1st of October. This is the last occasion on which the distribution of prizes will be held in March.

Out of the eight medals and prizes awarded no less than four go to Raghonath Koshoo and I desire to congratulate him very heartily on his success in obtaining the Gold Medal for Honours, silver medals for Forestry and Botany and the McDonnell Memorial Prize for the best Kashmir or Punjab student. Another Kashmir student, Niranjan Nath Kaul, has taken the silver medal for Forest Engineering. The William Prothero Thomas prize for the best practical forester goes to Dwarka Nath Kharyal, also from Kashmir, the Fernandez Gold Medal for Utilization to Bageshwari Dayal of the United Provinces, and the "Indian Forester" Prize to Khan Mohammad of the Punjab.

I have repeatedly drawn your attention to the necessity for regarding forestry as a subject different from those one usually learns at school and college. It is a common-place to tell you that you are just beginning to learn your profession when you leave Dehra Dun, and above all things remember that you will never be a success as a forest officer if you put book-work and office-work first. A forest officer must live in his jungles, and, if he does not like the life, he had better choose some other career. A forest division cannot be run from an office. Nothing is more disheartening for subordinates than to receive a continual stream

of orders without practical instruction in the means of carrying them out.

I wish to express my gratitude to all the Instructors and the staff of the Forest Research Institute for the great pains that they have taken in imparting instruction to the Ranger students. The technical instruction at the Forest Research Institute is a very great asset to the College. We are also grateful to a number of officers of the United Provinces Forest Department for their kindness in looking after the classes when on tour, especially Messrs. Marriott, Rai Bahadur M. P. Bhola, Hopkins, Stewart, Hall and Khan Bahadur Sheikh Mohammad Rahmat Ullah.

I know that I am expressing the sentiments of all the staff and all the students when I say we are all very sorry to lose Mr. Cornwell. He has been with us for 5½ years and has during that period never spared himself in any way to improve the efficiency of the students at the Rangers College, not only in work but also in games and athletic sports. Mr. Cornwell will be very greatly missed when he goes on leave before returning to Madras, and we wish him the best of fortune there. Mr. Mobbs has arrived to take Mr. Cornwell's place and we welcome him to the College.

Mr. Simmons, Professor of Forestry at the College, goes on leave next month and he will also be very greatly missed both in the lecture rooms and on the playing fields. Mr. Simmons has always taken the greatest personal interest in the Rangers College.

It is now my pleasant duty to distribute the prizes and certificates."

RESULT OF THE FINAL EXAMINATION OF RANGERS CLASS
OF 1928—30.

Honours Certificates.

1. Raghonath Koshoo ... Kashmir.
2. Dwarka Nath Kharyal ... Kashmir.

Higher Standard Certificates.

3. Bagheshwari Dayal ... United Provinces.
4. Niranjan Nath Kaul ... Kashmir.
5. Khan Mohammed ... Punjab.
6. Alam Singh ... United Provinces.

7. Hans Raj Kapur ... Punjab.
8. Jamal-ud-Din ... Punjab.
9. Abid Hussain ... Kashmir.
10. Udyanand Lakhera .. Tehri.
11. Shams-ud-Din ... United Provinces.
12. Ved Brat Singh ... Tharoach.
13. Deva Nand Saklani ... Tehri.
14. Niranjana Lal ... Private.
15. Abdul Razzak ... Punjab.
16. Atta Elahi ... Punjab.
17. Ali Mohammed Khan ... Kashmir.
18. Satya Narain Prasad Nautiyal Tehri.
19. Chandra Prakash Goel ... United Provinces.
20. Tek Chand ... Delhi.
21. Ram Prasad Dobhal ... Tehri.

Lower Standard Certificates.

22. Govind Vyan Katesh Surange Gwalior.
23. Ghazanfar Ali ... Punjab.

Medals and Prizes.

1. Gold Medal for Honours ... Raghonath Koshoo, Kashmir.
2. Silver Medal for Forestry ... Raghonath Koshoo, Kashmir.
3. " " „ Botany ... Raghonath Koshoo, Kashmir.
4. " " „ Engineering N i r a n j a n Nath Kaul
Kashmir.
5. McDonnell Memorial Medal Raghonath Koshoo, Kashmir.
for best Kashmir or Punjab
student.
6. William Prothero Prize for Dwarka Nath Kharyal,
best Practical Forester. Kashmir.
7. Fernandez Gold Medal for Bageshwari Dayal, United
Utilization. Provinces.
8. " Indian Forester " Prize Khan Mohammed, Punjab.
(consolation).

REVIEWS.

**REVIEW OF FOREST ADMINISTRATION IN BURMA
(INCLUDING THE FEDERATED SHAN STATES)
DURING THE FIVE YEARS FROM 1ST APRIL,
1924 TO 31ST MARCH, 1929.**

One of the most interesting reviews of Forest Policy in the Indian Empire that has appeared of recent years has been published by the Government of Burma under the following resolution, which we quote in full :—

“Resolution.—The review will be published for general information. It is of special interest since it covers the five-year period which succeeded the introduction of the Reforms and the treatment of Forests as a transferred subject. This transfer made no change in the Forest Policy of Government. As before, that policy is directed towards the conservation and development of Burma's magnificent forests in accordance with a carefully thought-out programme and the Ministry notes with pleasure the steady progress made in the working out of this policy. Its thanks are due to the Forest Department generally and in particular to its Chief Conservator, Mr. H. W. A. Watson. Mr. Watson has been at the head of the Department for the greater part of the period covered by the review, and the review itself bears eloquent testimony to his skilful and successful administration. Mr. Watson proposes to go on leave preparatory to retirement in May next. The province will be the poorer for his departure, and the Government of Burma places on record its high appreciation of his distinguished services.”

On 31st March, 1929, there were 90 officers serving in Burma, as compared with a sanctioned cadre of 113 for the combined Indian Forest Service and Burma Forest Service Class I. A certain amount of difficulty has been found in obtaining a sufficient number of satisfactory recruits for the new service, as was to be expected with such great changes, but it is hoped that this will soon be surmounted.

One thousand five hundred square miles were added to the reserved forests in Burma and the Shan States during the five

years. This is good progress and indicates that some of the valuable unclassed forests are being brought under reservation, the only way to ensure that they are preserved. The Chief Conservator of Forests would like to see 30 per cent. of the area of Burma as reserved forest, instead of 12 per cent. as at present, but even now Burma is not so badly off, as Bengal has only 7 per cent., the Punjab 1·5 per cent., and the United Provinces 5 per cent.

We are glad to see that the Chief Conservator of Forests approves of 4 inch maps instead of 2 inch for valuable reserved forests, and it is believed that this opinion is shared by most of the officers who have had to make working plans in Burma.

Reference is made to the valuable air reconnaissance made in Tenasserim by Messrs. Scott and Robbins over 15,000 square miles. This has already been fully reported on and discussed.

The area under sanctioned Working Plans was nearly doubled during the five years in Burma proper, the figures being:—

April 1st, 1924	...	...	10,269 sq. miles.
March 31st, 1929	...	...	18,915 sq. miles.

This is progress indeed and it is to be wished that other provinces could show an equal advance.

The revenue of the Forest Department in Burma comes largely from teak so that the following figures are interesting:—

Average number of teak trees girdled annually			
1914—19	...	...	198,000
Average number of teak trees girdled annually			
1919—24	...	...	223,000
Average number of teak trees girdled annually			
1924—29	...	...	207,000

In view of the steady diminution in the number of over-mature trees available for girdling, the number of girdlings is certain to decrease in future years.

It is satisfactory to note that teak is to be planted wherever possible; the total area of the plantations in Burma is estimated at 131,000 acres.

Forest Research plays an important part in the programme of the Forest Department in Burma, and Economic Botanical, Entomological and Silvicultural research all made much progress.

Two thousand miles of unmetalled roads and 4,000 miles of graded bridle paths were in existence under the Forest Department in 1929.

During the five years 1,207 wild elephants are said to have been captured.

As might be expected under such a progressive Forest Department the financial results were satisfactory, the average annual surplus increasing from 62 lakhs in 1914-15 to 1918-19 to 118 lakhs in 1924-25 to 1928-29.

FOREST ADMINISTRATION REPORT OF BIHAR & ORISSA, 1928-29.

The financial results for the year were good, there was an increase of surplus by one lakh over last year. The average surplus for the last five years was Rs. 1,72,627 against Rs. 1,58,666 in the previous quinquennium.

The following is an extract from the Government Resolution :—

“ Financial Results.—The revenue, expenditure and surplus of the year were Rs. 10,97,161, Rs. 8,50,373 and Rs. 2,46,788 respectively, against Rs. 9,38,760, Rs. 7,92,460 and Rs. 1,46,300 in the previous year. To this surplus Rs. 2,28,000, being the value of free grants and loss of revenue by sales at privileged rates, may be added. The increase in revenue is mainly due to the higher prices obtained from sale of annual coupes, a successful lac crop in Palamau, and to the realisation of arrears due from certain contractors. The Governor in Council notes with satisfaction the steady increase in revenue and hopes that with the opening of the new Railway line the Palamau Division will show better results.

Research work.—Experimental work was concentrated mainly upon research into natural regeneration of sal and a new

scheme of investigation involving the classification of sal forests into three main types was introduced. Experiments in artificial regeneration also continued as in the previous years. The experiment in the Kolhan Division regarding the possibility of forming *sabai* grass plantations has given very favourable results.

Efforts to popularise slab and half round sleepers were not successful as they have no alternative sale when rejected by the Railways. Progress with lac plantation continued and a new plantation in the Santal Parganas was begun during the year. An area of reserved forests in the Sambalpur East Division containing a large number of *palas* trees is being converted into a lac area.

* * * * *

Staff and Organization.—There was no increase or decrease in the cadre of the Imperial and Provincial Forest Services which remained at 17 and 8 respectively, but sanction of the Secretary of State has been obtained since the close of the year to the abolition of one major charge for Mayurbhanj State and of two temporary major charges for the private forests and to the conversion of the Kolhan Division into a major charge. This has reduced the strength of the cadre of the Imperial Service from 17 to 15 and the number of major charges from 13 to 11. One officer of the Imperial Service has been kept as supernumerary.

* * * * *

Messrs. R. G. A. Hannah and E. R. Comber, the two officers in the listed posts of the Imperial Service, retired during the period and their places were filled up by Messrs. O. A. Dods-worth and Dilawar Husain Khan."

ANNUAL REPORT ON GAME PRESERVATION IN BURMA, 1928-29.

This is one of the most interesting reports that have appeared from the pen of a forest officer in India, apart from technical reports on forestry. Mr. H. C. Smith, I.F.S., the Game Warden in Burma, puts before the public very clearly the dangers which threaten the indigenous fauna of Burma and it is to be hoped that his words will have some effect. It seems a pity that the Press

have valued this small pamphlet at two rupees, as it is desirable that it should reach as large a public as possible.

Burma with its large area of forests has always had a special interest for lovers of animals, if only from the occurrence of two animals which do not occur in India, the banting or *saing* and the brow antlered deer or *thamin*. There are in addition many elephant, bison, bear, sambur, hog deer, barking deer, serow and rhinoceros as well as carnivora, and the large blocks of forests have, until recently, given these animals a certain amount of protection. With the spread of cultivation and the large increase in the number of gun licenses, this immunity is passing away. Mr. Smith makes some very plain and pointed statements such as :—

“The subject to which this chapter is devoted is one of vital importance to game preservation since in the effective control of fire-arms and ammunition lies the only hope of preventing the wild fauna of the province from being exterminated.

A modern gun or rifle in the hands of a bare-footed native hunter is a most deadly weapon and particularly so when the owner disregards all laws framed for the perpetuation of wild life. To-day there are thousands of fire-arms in Burma in the possession of people who care naught for the Game Rules and to whom the slaughter of wild creatures presents little difficulty with a modern weapon. The number of these fire-arm licenses is now so great that it appears to be well nigh impossible to control their activities and as a result indiscriminate slaughter in contravention of all protective legislation continues and is likely to continue until the fauna has been exterminated unless determined efforts are made to check this extermination.

It is generally admitted that the most rational and generally economical remedial measure would be to restrict the issue of fire-arms licenses to those who are

competent to handle modern weapons and who can be relied upon to use them for legitimate purposes only. Action on these lines would automatically reduce the number of fire-arms in the province by at least 60 per cent., that is by approximately 25,000, which would go a very long way towards solving the problem. Unfortunately, however, such a measure would be in direct conflict with the existing policy.

It will thus be seen that an attempt is being made to pursue two conflicting policies, one of which virtually amounts to the arming of expert poachers, whilst the other is to protect game."

In all writings about the protection of game in India and similar subjects it is customary to refer to the necessity for "educating public opinion". This is a pleasant phrase, but what does it amount to? The ordinary Indian or Burman cares nothing at all for the preservation of wild life, nor for the study of nature, and a wild animal is to him something which can be killed and sold or eaten. The writer doubts whether it will ever be possible to bring the people most concerned to such a frame of mind that they will help to protect wild animals. The *only* means to protect game is to restrict the number of guns in the hands of the population and that seems to be at present an extremely difficult, if not impossible, thing to bring to pass.

It is pleasing to find that a new sanctuary has been established to protect the almost extinct *Rhinoceros sondaicus* a species that has been almost exterminated, largely by poachers from Siam. The lust for slaughter does not stop at the large animals, jungle fowls, pheasants and squirrels being also accounted fair game and apparently disappearing rapidly in certain parts.

Mr. Smith refers to the "Society for the Preservation of the Fauna of the Empire" whose headquarters are in London and we desire to bring the society to the notice of all forest officers. The annual subscription is only 10 shillings per annum.

It will surprise many people in India to read that the following carnivora were killed in Burma during the year—

492 tigers,
1,242 leopards,
1,119 bears,
219 wild dogs.

388 elephants were captured during the year, and 85 are reported to have been shot.

We commend this report to all Forest Officers and Local Governments as a model of what should be done, or at any rate attempted, if our wild animals are not to disappear entirely.

CLASSIFICATION OF THINNINGS.

THE INDIAN FOREST RECORD, VOL. XV, PART I.
CALCUTTA, GOVERNMENT OF INDIA, CENTRAL PUBLICATION
BRANCH, 1930. PRICE 14 annas OR 1s. 6d.

The classification was approved by the Silvicultural Conference which met at Dehra Dun from March 14th to 20th, 1929, in revision of the classification approved by the 1922 Conference and published in Forest Bulletin No. 52 in 1922.

A common standard of reference is of the greatest help and this little book is excellent.

A GLOSSARY OF TECHNICAL TERMS FOR USE IN INDIAN FORESTRY.

THE INDIAN FOREST RECORD, VOL. XV, PART II, 1930.

The new glossary was taken in hand at the Silvicultural Conference held at Dehra Dun in March 1929.

The original glossary was compiled in 1908 and revised in 1911. At the Third British Empire Forestry Conference held in Australia in 1928 certain definitions were accepted and recommended for use in all parts of the Empire. These have been incorporated.

Appendix III gives the Forestry terms used in the United States of America and their English equivalents.

We wish to draw the attention of all Forest Officers to this useful publication. The price is As. 6 or 8*d.* from Calcutta, Government of India, Central Publication Branch.

EXTRACTS.

CONSERVATION OF SOIL AND WATER.

H. W. R. BERTRAND, F.L.S.

Govinna Estate, Govinna.

Two simple methods have been adopted here and on other places the writer is interested in. While it is not held that either does away with the handicap which land opened on the old style suffers, they are both useful and have been found to increase yields by a statistically noticeable amount.

1. When drains come up for deepening they are not cut to the full depth throughout their length. Sections about 8 feet in length are deepened leaving blocks of 2 feet uncut. Such blocks should of course not be left so high as to cause the drain to overflow. The effect of this system is to convert each drain, at less than the ordinary cost of deepening, into a series of water-traps.

2. In the autumn it is the custom here to cut two pits per chain of drains. The pits measure 6 ft. by $1\frac{1}{2}$ ft. by 2 ft. deep (below the bottom of the drain). These pits are left open until the wintering is over; then, in April, surplus women and children are employed sweeping all the leaves from the drain and from 2 feet on each side of it into these pits. The leaves are thoroughly well mixed with a little of the red earth and are tramped down. The top layer is sprinkled with from 2 to 3 lb. of cyanamide to promote breaking down.

These "sponge-pits," as they are called, soon become invaded by masses of roots. Their effect is particularly noticeable during droughts, more so should, during that time, a short heavy shower fall, the majority of which is usually shot off the land.

The distances given are approximate. It is a mistake to cut more holes than the leaves in the drains only will fill unless there is green manure or jungle stuff handy.

The method has the additional advantage that clearing of drains may be started before the heavy rains, which usually carry off so much valuable leaf, begin.

(Tropical Agriculturist).

FORESTRY FACTS AND FIGURES

STANDARD TRADE NAMES OF EMPIRE TIMBERS.

The Empire Forestry Association with financial assistance from the Empire Marketing Board, have just published a Handbook, which it is hoped to continue annually. The book is particularly interesting to the timber trade, because it contains a list of standard trade names of Empire Timbers, as adopted at the Empire Forestry Conference of 1928 in Australia and New Zealand. The list includes the botanical as well as trade names, also other names commonly used by the trade for the same trees, and information as to countries from which the wood can be obtained commercially. The book gives the names and addresses of forest officers of the Empire at home and abroad and other useful information as to the membership and activities of the Empire Forestry Association. It may be obtained by non-members for 3s. 6d.

(*Timber Trades Journal*).

RARE ANIMALS OF THE EMPIRE.

SANCTUARIES FOR WILD LIFE.

The annual meeting of the Society for the Preservation of the Fauna of the Empire was held last evening at the offices of the Zoological Society, Regent's Park. Lord Onslow, the president, was in the chair.

The report of the executive committee stated that since the last report the acting secretary had made a visit to America solely with the object of enlisting the co-operation of American conservationists in the work of the society. An influential committee had been formed in New York, under the auspices of the Boone and Crockett Club, with Mr. Madison Grant as chairman, and it included such notable men as Professor Henry Fairfield Osborn, Colonel Kermit Roosevelt, Mr. Childs Frick, and Major F. R. Burnham. This committee had charged itself with the collection of a fund to promote efforts with which American conservationists are in sympathy, and it was believed that the society would thereby receive substantial help. The Wild Life Protection Society of America had also, through Dr. Hornaday, generously made a contribution to their funds.

"It was impressed on our secretary in America," the committee added, "that it was expected that any help forthcoming from the citizens of U. S. A. would be equalled by similar support from our own people. We are confident that this will be the case, but definite efforts are necessary, and we urge our members not to fail us in this respect. The need is urgent. To meet changing conditions we must extend the sphere of our activities. The character of our endeavour during the next 10 years will do much to decide the fate of the wild life of the world. This may sound ambitious, but as some 70 per cent. of the larger mammals of the world are in this Empire,

the responsibility resting on those who claim its citizenship is not to be disregarded. This society, based as it is in the capital city of the Empire, and with its 25 years' record of achievements behind, can, it is submitted, claim to be the correlating focus of wild life conservation for the Dominions, Colonies, and Dependencies which all go to make up the Empire of to-day."

POLICY IN MALAYA.

The committee are in correspondence with the Colonial Office with regard to the consolidation of measures for the better protection of wild life in Malaya, and it is hoped that one of the results will be the proclamation of a great central sanctuary. They also have a sub-committee investigating the possibility of widening the scope of the society's influence by a scheme of affiliation or co-operation with other societies throughout the Empire which have similar aims.

LORD ONSLOW, in moving the adoption of the report, said since their last meeting *their patron, the Prince of Wales, had proceeded on a visit to Africa for sport and travel.* The society sent him a telegram wishing him good luck, to which he had sent an appreciative reply. They deeply regretted to read that morning that the Prince had been attacked by malaria, and he was sure he was voicing the wishes of all the members of the society in saying that they hoped for him a very speedy recovery.

Reference was made in the report to the visit of Mr. Hobley, the acting secretary, to America, and they were grateful to him for the success that had attended his efforts. The membership of the society had increased since the last meeting and was now 760. But they remained, on the whole, a small society, and they looked for an increase in their membership so that they might have the help of a weighty public opinion to enable them to prevent the destruction of wild game. There was a necessity for the pressure of public opinion in favour of the objects of the society. The fate of wild game hung in the balance. Speaking generally, it had never been in danger on a considerable scale before, but now its existence was threatened by a combination of modern weapons of precision with modern mechanized methods of transport.

SANCTUARIES.

That society wished to carry preservation much further than it had ever been carried before. That must be done if wild animals were to be preserved in their wild state. As time proceeded it became more necessary to stabilize reserves by establishing them as absolute sanctuaries. That had been done in America and other countries and it was by the establishment of National Parks in the future that this problem would probably be solved.

He was glad to say that a debate which took place in the House of Lords elicited a satisfactory reply from Lord Passfield, both as to the general policy of the Government in regard to game preservation and to an assurance that the monstrous practice of slaughtering game from motor-cars would be severely dealt with.

Zoos.

The society was meeting that day, as usual, under the auspices of the Zoological Society, and he expressed appreciation of the important part which zoological gardens played in regard to the preservation of game. People saw there live wild animals, which was a very different thing from seeing as stuffed one in a museum, and their sympathy with efforts to preserve them from extinction was increased.

The report was adopted

An African game film taken by Mr. W. T. Patterson was then exhibited.

The President said Mr. Patterson was an American sportsman, and the scene of much of his film was the Serengetti Plains in Tanganyika Territory. The Serengetti Plains were the region which was under discussion in *The Times* last year as being the place where an excessive amount of slaughter had been carried out by the help of the motor-car. Mr. Patterson was, however, not one of those offenders, being a sportsman of the best type, and although he collected a certain number of picked heads, he devoted, as they would observe, quite as much time to photography as to shooting. Part of the Serengetti region had now been proclaimed a reserve by the Tanganyika Government and powers had been given under which severe penalties could be imposed on those who considered it to be amusing to chase beasts with a car and then shoot them when they were too exhausted to run away.
(*The Times*.)

ECONOMICS OF FORESTRY.

An inquiry into the economics of forestry has just been completed at the Imperial Forestry Institute. The subject has never yet received the amount of attention which it merits, according to the view of Mr. W. E. Hiley, who has been responsible for the investigation. Mr. Hiley said to-day that he did not believe that the fears of a timber famine, which have recently been expressed in some quarters, were well founded. A rise in timber prices, followed inevitably by the increase of available supplies and decrease of consumption, would, he thought, avert a famine. Nevertheless, the fact that the world's forests were being cut down by lumberers who were making no provision for their regeneration was a very grave one.

The planting of forests was an expensive undertaking, and the Forestry Commission would in the near future be spending upwards of half a million pounds each year on the initiation and upkeep of plantations. Private landowners, too, were spending large sums on these objects. Since forest rotations were so long, a planter seldom saw the fruition of his work. It was very important, therefore, that his planting schemes should be carefully thought out, so that his successors might reap the greatest value

from each pound sterling which was spent now. Some species of trees grew very much faster than others and yielded saw-timber on a shorter rotation, but it might happen that the timber of a slow-growing species was of special value. Thus Douglas fir grew much more quickly than larch, but a cubic foot of larch timber was worth twice as much as a cubic foot of Douglas fir. Also one species might give valuable yields in the form of thinnings, whereas the thinnings of another species might be almost valueless.

By allowing a fixed rate of interest they could calculate the cost of growing timber of various species and select those methods which were likely to give the best relation between the costs of production and market price. The results of such investigations were startling. Thus, if 4 per cent. compound interest were allowed on money during the period over which it was invested, it might be shown that the cost of producing Scots pine varied roughly from 1s. 6d. to 4s. per cubic foot, and oak 3s. 6d. to 12s. whereas Sitka spruce and Douglas fir could be produced at a cost of 4d. to 9d. per cubic foot. These were extreme cases, and the cost of producing other timbers generally lay between the figures given.

Mr. Hiley is about to publish the results of his investigation in book form. *(The Times.)*

WHITE RHINOCEROS.

That the white rhinoceros is by no means near extinction appears to be proved by a report submitted yesterday to the Game Protection Committee by Mr. Harris, the entomologist in charge of the operations carried out in Zululand for the extirpation of the tsetse fly, the carrier of the germ of the disease in cattle known as nagana.

Mr. Harris, in his report, states that his preliminary operations involved the reduction of the commoner game outside the reserves and driving the balance into those areas, and also a survey of the Umfolozi game reserve and the animals at present in it. Up to the present the number of white rhinoceros in the reserve had been estimated at a maximum of 40, but as a result of his survey Mr. Harris is satisfied that over 150 specimens exist, the ranger and the native game guards having counted 75 males and 82 females, as well as 15 half-grown animals and calves. Thirty-four were seen in one day, and many of the animals were counted while sleeping or wallowing, quite unaware of the proximity of man.

(The Times.)

THE PROTECTION OF GAME.

SIR,—I hope you will permit me to add my views with reference to your leader about the prevention of the extermination of fauna. I think if the licensing authorities were to be a little less generous in issuing licenses and were to punish those persons who take out licenses for protection of

fields, and use their weapons for sport, there would be no need for any legislation on the matter. At present there are many thousands of possessors of firearms who have licenses for the protection of fields, whereas they are actually using their weapons for sport. A good few of these make a livelihood by selling the game shot by them.

The Bayhailias are the worst offenders with their matchlocks and muzzle loaders. Besides being illiterate they have not got a sporting instinct. They use a camouflage for stalking game of all descriptions, such as carrying a bundle of straw or hiding behind a cow or buffalo calf.

I have been a *shikari* for the past twenty years or thereabouts and find year after year matters are growing worse, in fact one feels scared to go out nowadays as at times bullets and shots go whizzing and whistling all over the jungle. It puts one in mind of being on a battlefield instead of being out for sport and pleasure.

A measure ought to be introduced where all undesirable persons, such as Bayhailias sepoys, constables and barkandazs and people in the same category, should have their licenses cancelled, and fines or other punishment should be imposed upon those persons who are license holders for protection of fields and use their arms for sport

Ghazipur, Nov. 18.

A LOVER OF SPORT.

(*Statesman.*)

INDIAN FORESTER

JULY 1930.

SOME ASPECTS OF THE SLEEPER QUESTION IN INDIA.

[At the request of Mr. H. C. B. Jollye, Timber Advisory Officer with the Railway Board, a Railway Engineer of wide experience, has written the following account of his practical experience with various kinds of sleepers. We think we have here a fair and unprejudiced statement of facts which will interest Forest Officers and convince them that the policy of keeping all kinds of sleepers in competition is sound from the point of view of the Railways and the general public. HON. ED.].

A general examination of the sleeper position on the railways of India before the War would have brought to light the fact that wooden, cast-iron and steel sleepers were all extensively used, but that they were not in any way evenly distributed throughout the country. On many railways wooden sleepers were apparently universal, while other railways or groups appeared to go in for the use of either cast-iron or steel sleepers on a large scale in certain areas. Generally speaking, it may be taken that where wooden sleepers were available in ample quantities and at cheap rates, they entirely eliminated any form of metal sleepers from the line. Where, however, the source of wooden sleeper supply was at a considerable distance, or the local demand for timber for other than railway purposes tended to put up the cost of wood, metal sleepers were used to fill the gap. In certain areas, centred generally round the coal-fields of Bengal and Bihar and Orissa,

and also in the neighbourhood of ports at which cast-iron sleepers from foreign countries could be obtained, many miles of track laid with cast-iron sleepers were to be found. Similarly in other definite areas, less conveniently situated for the use of cast-iron and also at a geographical disadvantage from the wooden sleeper point of view, many miles of track laid with steel sleepers were in existence. As examples of the above, the North Western Railway may be quoted as a line which was laid almost exclusively on wooden sleepers due to its easy access to the deodar forests in the neighbouring Himalayas and Kashmir. The B. & N. W., and R. & K., E. B. (metre gauge) and A. B. Railways easily obtained wooden sleepers from the sal forests in their neighbourhood. The E. I. Railway less conveniently situated for wooden sleepers possessed many hundreds of miles of line laid with the celebrated Denham Olphert type of cast-iron sleeper. In Central India and the Deccan there were many miles of steel sleepers.

2. As in so many other matters the war tended to upset the existing state of affairs and before matters could become normal a policy of extensive construction of new railways was put into operation which increased the demand for sleepers of all kinds to an enormous extent. It can be accepted generally that the price of wooden sleepers tended to drop towards the pre-war level more tardily than the price of steel and cast-iron and further while the latter have practically gone back to pre-war levels, it is believed that the price of wooden sleepers will never approach anywhere near the same condition of affairs.

3. *Relative costs.*—Of late sal sleepers have been placed on the market at Rs. 7-8-0 per broad gauge sleeper, deodar at Rs. 6-8-0, creosoted chir and fir at Rs. 5, while cast-iron and steel sleepers have been obtainable at between Rs. 9 and Rs. 10 per sleeper. It is quite evident that given similar conditions of freight and accepting the recognised lives of the various types of sleepers, the wooden sleeper, especially the untreated wood, is decidedly more costly, taking into consideration first cost, replacement, etc., than the metal sleeper. This point will naturally lead to a discussion as to whether the period of life adopted bears any relation to actual

facts. Opinion will no doubt vary in different parts of India and under different conditions, but the writer has actual experience of a quantity of steel sleepers, which had already been in the line about 25 years, being relaid in a new branch line in 1910 where he has recently inspected them still in sound condition. It is also well-known that cast-iron sleepers are still in serviceable condition in the track which have been laid at least 50 years. Another point indicating the probable life of metal sleepers is that on the E. I. Railway the regular allotment of cast-iron plates to replace breakages of Denham Olphert type of sleepers is 1 per cent., thus proving that such sleepers are capable of an average life of at least 50 years. It can safely be said that the majority of engineers who have had experience with metal sleepers of all kinds will consider that the adopted lives of 30 and 40 years in the case of steel and cast-iron sleepers respectively are much more likely to be under than over the mark. In the case of wooden sleepers, however, where 15 years is taken as the average life, it would generally be found that this is considered optimistic by railway maintenance engineers.

4. A word of explanation is here required as to why, if the wooden is more expensive than the steel sleeper, railways are still purchasing such large quantities of wooden sleepers. The explanation is quite simple. The total number of sleepers laid in the track throughout India must have a considerable bearing on the number required annually for replacements. Unless a section of the line is to be relaid entirely, it is necessary that wooden sleepers should only be replaced with wood and metal sleepers with metal, otherwise a bad running track is produced. It is estimated that there are at present the following numbers of sleepers of the three kinds in the Class I Railways of India :—

		Broad Gauge	Metre Gauge
		Millions.	Millions.
Wooden	...	28·3	22·3
Cast-iron	...	24·0	2·0
Steel	...	9·3	5·6

It will be noted that the proportion of cast-iron sleepers on the metre gauge railways is very much lower than that of the

broad gauge. This seems to be due to the absence of metre gauge lines from the geographical areas most suitable for the use of cast-iron.

5. A certain proportion of the wooden sleepers is being replaced annually by metal sleepers, but even if half the renewals consist of metal, it will still be necessary to obtain one million new wooden sleepers to put in the line annually to replace those worn out.

6. Further, cast-iron sleepers are quite unsuitable for laying on unconsolidated banks in new lines where wooden sleepers are also undoubtedly superior to those of steel. Steel sleepers are unsuitable for use in soil containing saltpetre and with slag ballast although very little of the latter is to be found in India yet.

7. It can be accepted, therefore, that railways must continue to use all three types of sleepers, but in the event of the cost of any one type becoming unduly high for its relative value, railways can reduce the number of that type very considerably.

8. MERITS OF DIFFERENT TYPES OF SLEEPERS.

Wood.—Its general use throughout the world is sufficient to prove that wood is one of the best materials for railway sleepers obtainable. Among its merits, the sleeper is easy to handle, easy to pack, gives very good running, can be used on new banks or with any type of ballast from good broken stone to ordinary earth, stands up under derailment and the track can generally be restored on the same sleepers without much loss of time. Among its demerits are the following:—The fastenings tend to work loose and spread, the gauge varies, it requires special contrivances to control that bugbear of railway maintenance termed creep, it can be destroyed by live cinders dropped from engines, and its scrap value is practically nil. Further its life is relatively short involving not only the cost of a new sleeper but also the cost, inconvenience and interference with traffic involved in the process of re-sleeping. There is also the consideration that it is more difficult to obtain wooden sleepers of uniform quality

owing to the variety of sources from which they have to be purchased and the possibility of variation in standards of passing.

Cast-iron.—This material provides a cheap sleeper, easy to handle. The gauge remains constant for an almost indefinite period, fastenings remain tight, and there is no creep. The scrap value is relatively high. Its demerits are that it can not be used on new banks. It must have a good type of ballast and if stone ballast is used it must be broken smaller than ballast for wooden sleepers. Under derailment, a large proportion of the sleepers will be broken and useless for further work. It is sometimes claimed that more skill is required in packing cast-iron sleepers, but the writer does not hold this view. Gangmen who have been trained to maintain a cast-iron road can do so just as efficiently as those accustomed to a wooden sleeper road. Further it has been noticed that such gangmen if transferred to a wooden sleeper road are just as much at sea as in the opposite case.

Steel sleepers.—These are cheap and very easy to handle and quick to lay. They are not as good as wood on new banks, but can be laid if necessary without much loss of efficiency. They require stone ballast to be broken small but can be efficiently used in gravel or sand ballast. The gauge remains constant and the fastenings tight and there is no creep. The sleepers are badly damaged in the case of a derailment and would be costly to recondition for use in the track. They have a long life and their scrap value is high. As in the case of cast-iron sleepers, men experienced in their use can probably maintain just as good a road as on wood.

9. Other objections have been raised to metal sleepers, one of which is noise. This is a very debatable point. It must be recognised that every type of sleeper gives a different sound under running trains. Some types of cast-iron sleepers are undoubtedly noisy. Some types of steel sleepers also have been found to be noisy. The writer knows of one type of cast-iron sleeper which is definitely quieter than any wooden sleeper. It would probably be accepted by the majority of maintenance

engineers that there need not be any more noise in travelling over metal than over wooden sleepers.

10. It is sometimes claimed that rolling stock incurs more wear when used over metal sleepers. This, I believe, is assumed to be accounted for by the fact that there is a certain "give" in the wood and none in the metal sleepers. Any one who has experience in maintaining a track knows quite well that the "give" in the track is due to the "give" of the ballast far more than to the "give" in the timber of the sleepers. It is also debatable whether any "give" in the track is likely to shorten or prolong the life of rolling stock, and the tendency of any "give" must be to increase the noise when the wheels pass over the joints of the rails. It is probable that the general consensus of opinion of experienced men would be that the life of the rolling stock would be greater where there is no "give" at all in the track. In any case there is certainly no evidence to show that the rolling stock of, say, the E. I. Railway which runs chiefly over cast-iron sleepers wears out any more than that of other lines where wooden sleepers are mostly used.

11. Where track circuiting is required, such as in the neighbourhood of big stations, metal sleepers are not suitable. It is undoubtedly the case that a wooden sleeper enables the two rails to be insulated from each other much more easily than any form of metal sleeper, and it is likely that in such situations wooden sleepers would always be favoured rather than metal.

12. The objection to the steel or cast-iron sleeper that under derailment much greater damage is done than in the case of wooden sleepers, is not one that need be given much consideration as the number of derailments is comparatively small.

13. To sum up, as all three types of sleepers can now be obtained in India and as at present prices the steel and cast-iron sleepers are only slightly cheaper than wooden sleepers, it is likely that all three kinds will continue to be used in the future as in the past.

14. No mention has yet been made of concrete sleepers. A number of these has been tried out and although there have been

many failures some types have been evolved which stand up well under heavy traffic conditions. At the present prices of wood and metal the concrete sleeper is ruled out entirely on the question of cost, but should abnormal conditions recur it might become a practical proposition.

15. Regarding "specials" that is to say sleepers for use with points and crossings and on girder bridges, timber has so far practically supplied all demands. On girder bridges hard wood is almost exclusively used but for points and crossings deodar is used in some parts of the country.

16. Of late a steel crossing sleeper has been given a trial with excellent results. Should the trials continue to prove satisfactory it is probable that large numbers of these will be used in the place of wood. Its initial cost is about the same as that of wood and it has the advantage of a much greater life and also its fastenings stand so well that adjustments of gauge, required somewhat frequently with wooden crossing sleepers, are almost eliminated.

17. Conditions in India are very different from those in Europe where a timber sleeper is very cheap and probably lasts twenty years, but even in England large numbers of steel sleepers are now being put in the line. As railway maintenance engineers in England are notoriously conservative, it is, therefore, evident that the steel sleeper has been accepted as a good investment. The rust question is, of course, much more serious in England than in the interior regions of India, hence the acceptance of steel sleepers in this country has further proof of being a wise move.

AN ALBIZZIA HYBRID—A. GAMBLEI, PRAIN.

BY R. N. PARKER, I.F.S., FOREST BOTANIST.

In the *Indian Forester* for December 1925 I mentioned that a probable hybrid *Albizzia* was being grown in Dehra. The tree has now flowered at 4 years old and I think there is no doubt that it is *Albizzia Lebbek* Benth. \times *Albizzia lucida* Benth. The history of the tree is as follows :—In May 1925 seed of *Albizzia lucida* collected from a tree planted at the Forest College, Dehra

Dun, was sown with the object of growing a few specimens for the Arboretum. A few of the seedlings were obviously not *Albizzia lucida* seedlings and one of these survived and was planted in the Botanical Experiment garden. This is the one which has now flowered. As some seed was left over this was sown the following year but failed to germinate. Fresh seed was collected from the *Albizzia lucida* tree in the Forest College grounds in 1927 and again amongst the seedlings a few similar hybrids appeared. Special efforts were made to preserve these hybrids but they failed to survive the rains. In 1928 seed from the same tree was sown in a nursery bed. Amongst the *Albizzia lucida* seedlings a few hybrids appeared. All the *Albizzia lucida* seedlings died off and the hybrids alone survived for a time but the last of them was eaten off by white ants in the rains of 1929.

From these results it is evident that the *Albizzia lucida* tree in the Forest College grounds is regularly pollinated to some extent with pollen from another species of *Albizzia*. That this other species is *Albizzia Lebbek* is also certain as the flowers of the hybrid are larger than those of *Albizzia lucida* and distinctly pedicellate, characters which indicate *Albizzia Lebbek* alone of the species of *Albizzia* found in Dehra Dun.

Had specimens of this hybrid been sent me for identification with no indication of origin I should certainly have identified them as *Albizzia Gamblei*, Prain. I think there is little doubt that *Albizzia Gamblei* is in reality *Albizzia Lebbek* \times *Albizzia lucida*. Knowing that such a hybrid occurs explains the distribution recorded by Prain which for India is Kangra, Sikkim and the Naga Hills. *Albizzia Lebbek* is wild or cultivated everywhere in India, *Albizzia lucida* is cultivated in the Kangra district and is wild in Sikkim. If *Albizzia Gamblei* is a hybrid between these two species its occurrence in Kangra and Sikkim with no trace of it in the United Provinces is easily understood. The only other explanation excluding a discontinuous distribution which would be unique amongst north Indian trees, is to suppose that *Albizzia Gamblei*—a tree rare in Sikkim—has been found cultivated in Kangra.

SERAJ FOREST DIVISION.

BY A. M. DAVID, I.F.S.

Seraj Division originally formed part of Kulu Division and was made up of two ranges but in 1921, when departmental exploitation became the vogue, these two ranges were divided into four and a new division constituted. A chain of mountains cuts the division in half, one-half of which drains into the Sutlej river and the other into the Beas river. The Bashleo and Jalori passes, both over 10,000 feet, form the main lines of communication between these two halves and over the Jalori runs the Simla-Kulu-Leh road. The nearest railways are Simla and the recently opened station of Jogindar Naggar on the Kangra Valley Railway but neither of these termini are nearer than 50 miles to the division. The quickest way in, and out, is by motor lorry and a trip from Pathankot, the terminus of the broad gauge railway, is one of the best cures known for a sluggish liver but it is apt to make a weak heart still weaker.

Climate.—The average rainfall is 44 inches and the climate is glorious. Snow lies heavily above 5,000 feet during the winter and provides sufficient moisture for tree growth during the very dry spring, from April to the middle of July. The first fall usually occurs about the 15th of December but in heavy winters the snow may come very much earlier. March, April, October and November are the most delightful months of the year. The low shut in valleys are unbearably humid but the division is only cursed with one or two.

Topography.—The mountains run from 3,000 feet to 12,000 feet and above this stretch vast areas of grass, rocks and snow up to 18,000 feet. The ground is moderately steep to very steep and a few nullahs are precipitous. Three of the four main streams rise in the north and north-east and are fed by several smaller streams, all of which enable timber to be extracted profitably. The view from the Jalori pass is magnificent; on the south there are the Simla hills and on the north-west and north the great Himalayan range, Chamba and Bara Banghal.

Geology.—The principal geological formations are gneiss, shales, schists and quartzites with occasional bands of intrusive granite. Lime stone occurs in part of the division and extends up the Sainj Valley. The quartzite disintegrates into a sand and the gneiss and schists into a loam or clay. The sandy soil produces excellent *chil* (*Pinus longifolia*) forests and loams and clays support the best deodar crops.

Flora.—The main species are deodar (*Cedrus Deodara*), *kail* or blue pine (*Pinus excelsa*), *chil* (*Pinus longifolia*), spruce *Picea Morinda*, and fir (*Abies Webbiana* and *Abies Pindrow*). In damp localities there are extensive groves of horse chestnut, the well-known school boy's "conker" of which is soaked in water and then ground into flour by the poorer class of people. The minor species which at present are of no economical importance are walnut, ash, box and yew. The bark of the latter is used for tanning and the same applies to the bark of the ban oak (*Quercus incana*). Alder and shisham are sparsely distributed on the banks of streams and the former is in great demand as a fire wood and for use in water mills.

System of Management.—The six principal species mentioned above comprise the main forests which are divided into four classes:—

- (a) Reserved Forests—No rights of any sort allowed.
- (b) First class Protected Forests—Limited rights.
- (c) Second class Protected Forests—More extensive rights.
- (d) Undemarcated Protected Forests—All rights.

Forests on steep and difficult ground have been allotted to the Selection Working Circle and are being worked on the Selection system on a rotation of 150 years. The yield has been fixed for deodar only. The Regular Working Circle is made up of forests situated on moderate and easy ground and are being worked on the Shelterwood Compartment system on a rotation of 120 years. The prescribed yield is based on enumerations of all species (deodar, *kail*, *chil*, spruce and fir) in B. P. I. and down to 12 inches diameter. Regeneration under the Shelterwood system has given slow but excellent results and some of the regeneration areas are



A Fine View.



A Typical Village.

objects of art and as good as the best kept areas in Europe. A great deal of good work was ruined by the disastrous incendiarism of 1921 which laid bare extensive areas of deodar and *kail*, but most of these eye sores have been re-stocked artificially. The very people who assisted to perpetrate these criminal fires are now feeling the "draught," literally and metaphorically, because they can not obtain sufficient timber for building and repairing their houses. For forests outside P. B. I. a ten-year thinning scheme is in force which provides for subsidiary operations such as thinnings and improvement fellings. All trees felled in main fellings are converted departmentally and floated down to the depôt in the form of sleepers the bulk of them being 9 ft. and 10 ft. long by 10 in. \times 5 in. section. This work is the principal source of revenue. The Kulu Working Plan (Trevor), a silvicultural classic, requires no introduction.

Shikar.—The game list includes, baral, tahr, gooral, serow, barking deer, musk deer, brown bear, black bear and the ubiquitous panther. Pheasants (the five Himalayan varieties), chikor, partridges (black and hill), snow cock and a very few duck, teal and woodcock make up the small game list. Any form of shooting in the hills is strenuous and one has to work very hard for one's game. The baral are all Himalayan as opposed to Trans-Himalayan so that nothing over 22 in. can be expected. Both species, of course, are the same and the only difference is in the size of horns—the Himalayan baral having to surrender big horns for the privilege of leaving its natural home in Tibet to come down to the better feeding grounds in the lower Himalayas. Gooral are common but $7\frac{1}{2}$ in. would be the maximum horn measurement. Tahr are very heavily poached but there are one or two over 14 in. still to be had provided one has a steady head and a climbing rope. Black bears are common and so are panther but brown bear are difficult to find although they are fairly plentiful. The best time to shoot serow is in the depths of winter because the tracks are easily picked up and only endurance and a certain amount of bad language are necessary to take one up the hill and "jump" the serow. Once jumped the serow gives about 7 seconds for the shot. The kalij pheasant is the

commonest and the least sporting of the game birds. When "flushed" he flutters helplessly on to a tree. January is the time for monal and tragopan and grand sport can be had with these high flying birds. The best game bird of all is perhaps the chikor and like driven grouse he is extremely difficult to hit.

Fishing.—The Tirthan and Sainj streams hold brown trout and barbel and a few small mahseer where the streams join the Beas river. The trout are not so prolific as in the Beas, where they are put in from hatcheries near Naggar, but they are in much better condition, of greater depth, and full of life. They can be taken on any of the trout or salmon flies, preferably the March Browns, Coachman, Jock Scott, Butcher, etc. In heavy water a worm and ilderton tackle is very deadly: a small spoon or minnow is just as effective. The big trout, which lie out in the stream and are cannibal, can only be killed by spinning for them. The biggest brown trout recorded on the Beas was netted and tipped the beam at 9 lb. The fish take greedily in March and April when the season opens and are again well on the rise in October, the end of season.

The people are very poor and heavily in debt to the local *bunnias*. The ordinary villager is simple and indolent to a degree having no ambition beyond his sheep, goats, cows and fields. Their religion is more of a superstition and the outward sign of it is the *deota*. Besides this every nullah and hill top has a god who is called a *jogni*. These are the ones to propitiate when out shooting.

FIRE AND SAL REGENERATION.

BY E. O. SHEBBEARE, I.F.S.

The two sál divisions, Buxa in Bengal and Kamrup in Assam, are separated by less than two degrees of longitude and less than half a degree of latitude but the method of regenerating sal is entirely artificial (*taungya*) in the former and entirely natural in the latter.

This is not a matter of personal choice or caprice in either case. I have no hesitation, now, in saying that the Kamrup

method is impossible under present conditions in Buxa and the Buxa method, if not impossible in Kamrup, would at least be far less effective and far more expensive than the method employed there now.

The reason for this has in the past been explained, rather loosely (by me among others), as follows. In the days when burning was thought to be the worst enemy of sal, fire-protection was much more easily extended to the larger blocks of Buxa than to the more scattered ones of Kamrup which moreover enclose village lands in many places. In consequence of this Kamrup forests had not reached the completely fire-proof stage by the time that the chief drawback of protection, absence of regeneration, began to be noticed. In Kamrup it was not too late to burn, in Buxa (except in the more inflammable places where it would have done more harm than good) it was already impossible.

The above explanation is true but not the whole truth—there are other factors. The rainfall in Buxa averages about 160 inches, in Kamrup about 80. The Buxa forests are mostly on the flat and consequently more easily water-logged than the undulating, well-drained ones of Kamrup. The soil is also different, in Buxa old alluvium with little or no clay and in Kamrup largely laterite.

All these factors tend towards a dryer type of vegetation in Kamrup more prone to grass and less to evergreen than the forest of Buxa. To one accustomed to the moist condition of Northern Bengal, with dense evergreen undergrowth, the Kamrup sal forests appear more like those of other parts of India—(Bihar and Orissa, Western and Eastern Bengal and Dehra Dun are the only sal localities I have seen).

Further, the sal forests of Kamrup are practically pure and free from creepers, whereas those of Buxa contain many other species both in mixture with the sal and in intermingled tracts which contain no sal. The sal in Buxa is, however, considerably larger than that of Kamrup both in height, growth and girth ordinarily attained.

One other factor of a different nature also affects the method of working in the two divisions. In Buxa there is a demand for fuel, in Kamrup there is none. The fast-growing species which come up under fire-protection, both as a lower storey to the sal and on land unsuitable for sal, bring in a revenue of about Rs. 40 per acre on a rotation of 20 years. It is true that in Buxa the demand is not yet universal as it is in the adjoining Jalpaiguri division, but a steady income of Rs. 2 per acre per annum from this source in all the accessible forests cannot be ignored.

It is necessary here to outline the past history of the Kamrup and Buxa sal forests. Up to 1916 the history of both forests was practically the same. Fire-protection had been attempted for many years and had been successful in most places since the severe fire year of 1909. In both forests this had caused evergreen undergrowth to invade the sal to varying extents and by 1916 it was almost impossible to find a sal seedling more than one year old in either. In Buxa determined attempts to burn the forests were made experimentally in 1911 and 1912 without success very largely owing to *malata* (*Macaranga denticulata*) coming in instead of grass. At this time *malata* was believed to be a nurse for sal and many unsuccessful experiments were made to raise sal under its shade. When these failed an attempt to re-introduce grass by means of cultivation was tried, because abandoned village sites come up in grass, and it was only the cleanness of a cultivated plot made in 1916 with this object in view that suggested omitting the grass stage; sal was sown direct in the cultivation and *taungya* resulted.

Meanwhile, in Kamrup, Milroy, the then Divisional Forest Officer, had been impressed with the sal regeneration in grassy unprotected areas outside the reserves. The grass in the neighbourhood of seed-bearers was full of whippy sal saplings burnt back regularly by the annual fires. He persuaded his Conservator to allow him to abandon fire-protection.

Fire was introduced wherever it could be made to burn, undergrowth had to be felled to do this in most places at first, but the effect was cumulative and within a few years there was

a noticeable diminution of evergreen, and an increase of grass which had been entirely absent before in all the eastern reserves. From 1923 the believers in fire as a regenerating agent thought they detected some improvement but this was not sufficient to convince others. It was not until the bumper seed year of 1926 had covered the ground with seedlings that the evidence was more convincing.

I have visited the Kamrup forests three times only—in May 1925, September 1927 and February 1930. On my first visit I thought the scheme quite hopeless, firstly because I regarded the whippy coppice shoots of sal which one often sees in annually burnt grass rather as the last relics of a destroyed forest than as the beginnings of a new forest; and secondly because I doubted whether such shoots, whatever their origin, could be brought to the pole stage by fire-protection. In the reserves at that time, although fire was beginning to thin the evergreen and bring in grass there was practically no sign of anything that could be called established regeneration.

On my second visit I was less pessimistic but still not satisfied. The grassy areas in new reserves were beginning to grow up into pole forests wherever fire-protection had been fairly successful but, in the old reserves, I was not convinced that the one-year-old sal seedlings, the result of the previous season's seedfall, could be established. I had seen this stage reached often in Buxa.

On my third visit, this year, there was no longer any room for doubt—in the grassy new reserves the canopy, in well-stocked parts, had closed and was already killing out the grass; while in the old reserves a state similar to that of the grassy new reserves had been induced. The grass here was already stocked with saplings safely beyond the critical stage.

Several articles have appeared in the *Indian Forester* on the *taungya* method of regenerating sal but regeneration by the agency of fire has not yet been described, because its efficacy has only recently been proved. I give a very rough outline of the method here, hoping that those who have put it through and are well qualified to give details will do so.

The method is simple enough.

In pure sal forest, where the undergrowth is mainly grass, the overhead cover is removed, either in groups or strips, where patches of promising seedlings are already on the ground. The area is then burnt annually and the groups or strips enlarged gradually by further removal of the old crop.

In sal forest with an evergreen lower storey and undergrowth this evergreen is first felled and burnt in patches to induce grass (in such forests there is usually no regeneration on the ground owing to unfavourable soil conditions). Between these there are, of course, intermediate stages which are treated by intermediate methods. Burning is continued until the whole block is a sea of grass. When this stage has been reached early burning is resorted to in order to save the old crop from unnecessary damage and this is continued until there are sufficiently large areas fully stocked with seedlings in the fleshy stage to make fire-protection worth while. When this has been accomplished the remaining seed-bearers are felled and all saplings cut back to the ground (to ensure sound shoots) and the area rigidly protected from fire.

When the canopy has closed sufficiently to begin killing out the grass and the poles are old enough to withstand fire, early burning is again brought in and this, or occasional leaf-fires, allowed throughout the life of the crop.

The regeneration period is fixed at 20 years which, considering the progress which has already been made, would seem to be ample.

**A SYSTEM OF LOG MEASUREMENT IN SURMA
VALLEY IN ASSAM.**

BY P. N. ROY, FOREST RANGER.

A large number of logs are extracted every year from the forests of the Surma Valley by floating. The logs are measured and the royalty is assessed on their cubic contents at revenue stations situated on the banks of the rivers.

Only a small percentage of these logs are converted in saw-mills but a larger proportion is sawn by Bengali sawyers

either in the valley or in different parts of Bengal where these logs are exported in large numbers.

Tradition relates that some 70 or 80 years ago, some men in a village near Bengal set up as sawyers and in the course of a few years became dealers in sawn-timber as well as in logs.

These traders devised a system of measurement known as the "dingi" measure. In this part of the valley a small boat made of planks is called a "dingi" and these "dingis" are built in large numbers as the country is flooded every year during the rains.

The unit of measurement of the timber, so largely used for making "dingis", is itself called a "dingi."

It is, however, difficult to say what a "dingi" is, but the method of measuring the timber is as follows:—

In this system a purchaser measures only the circumference of the log at $1\frac{1}{2}$ cubits from its thin end and can then say without paper calculation, the number of "dingis" and fractions up to $\frac{1}{16}$ th of a "dingi".

It is astonishing to see that uneducated people have evolved a system from which they can make an exceedingly accurate estimate of the quantity of sawn timber by using such unorthodox methods.

The effect of this system on forest management is not, however, good. Purchasers generally advance money to those who work out timber from the forests. From the nature of this arrangement a big deduction, out of all proportion to the difference in quantity of timber, is made when a log happens to be below the standard length.

Small increase of a foot or two in length is neglected and it serves to decrease the "dingi" content which is based on the circumference near the thin end.

Thus there is a tendency to extract only logs of standard length. Length of utilisable timber can not always be expected to be multiple of the standard length, and a waste is inevitable.

Any one inspecting felling areas would be struck with the waste which can be avoided merely by extracting logs of varying lengths.

Happily sales are gradually, though slowly, being based on cubic-foot method merely on account of the fact that there is no room for mutual distrust between the purchasers and the sellers as the measurement is taken by Forest Officers for assessment of royalty.

SIR HUGH WATSON.

It was with the greatest pleasure that Burma Forest Officers opened their morning papers on the 3rd of June to find that at last H. W. A. Watson had received the recognition he so thoroughly deserved. Watson went on leave preparatory to retirement on the 19th of last month, and foresters generally felt that if ever any one in the Department had deserved recognition for valuable services it was he. This feeling was not confined to the Forest Department, but was shared by members of other Departments and firms who knew his worth.

Watson joined the service from Cooper's Hill in November 1897 and has over 32 years service. He is the last of a year of five—Troup, Todd, Cappel, Watson and Rorie—all of whom came to Burma. Of these Cappel died early, but, with the exception of Troup, who was translated to higher spheres, the others all in due course became Conservators in Burma. Watson spent the greater part of his early years on Working Plans, experience that was of the utmost advantage to him when, after holding charge of the Southern Shan States, Ruby Mines and Zigôn Divisions, he was called on to organise the Working Plans Circle on its formation in 1920. In most Departments, he would undoubtedly have been decorated in recognition of work such as he did in that Circle, but recognition comes tardily in the Forest Department. He held charge of the Working Plans Circle until 1924 and took over the office of Chief Conservator at the end of 1924. With the exception of a leave in 1927, he has been in charge ever since. During this time, he has shepherded the Department through the difficult period when it first

became a transferred subject under the Montague Chelmsford Reforms, and in particular rendered notable service on the Forest Enquiry Committee. The successful organisation of the new Burma Forest Service Class I to replace the Indian Forest Service in Burma under the new conditions is also largely due to his efforts. But apart from all this, his intimate knowledge of all branches of the work of the Department has helped him in an administration of the Department which will leave its mark on the country for many years.

No description however brief of Watson's career would be complete without mention of Mrs. Watson who has endeared herself to the whole Forest Department in Burma, and we all feel very lost at the departure of those whom we are now so delighted to call Sir Hugh and Lady Watson.

BIRTHDAY HONOURS' LIST.

We offer our congratulations to the following Members of the Forest Department who figure in the recent Honours' List published in the Gazette of India (Extraordinary) of 3rd June, 1930 :—

KNIGHTHOOD.

Hugh Wesley Allan Watson, Esq., Indian Forest Service, lately Chief Conservator of Forests, Burma.

COMPANION OF THE INDIAN EMPIRE.

Frederick Francis Ralph Channer, Esq., O.B.E., Indian Forest Service, lately Chief Conservator of Forests, U.P.

Lawrence Mason, Esq., O.B.E., M.C., Indian Forest Service, lately Chief Forest Officer, Andamans.

RAI SAHIB.

Lala Bhag Ram, Forest Officer, Baluchistan.

AHMUDAN-GAUNG TAZEIK-YA-MIN.

U. Me, Burma Forest Service, Extra Assistant Conservator of Forests, Burma.

INDIAN ANIMALS IN ENGLAND.

In the "Field" for March 29th, 1930 there are interesting notes on the acclimatisation of kalij pheasant and barking deer in England. It is reported that a kalij pheasant was killed in Herefordshire and that these birds have lived wild in the woods near Woburn, Bedfordshire, for a great many years. A barking deer was seen in the woods of Northamptonshire in 1915 but has not been heard of since. It is not known whether it was an Indian or a Chinese Muntjac.

REVIEWS.

REPORT ON THE FOREST ADMINISTRATION OF BURMA

(excluding the Federated Shan States), 1928-29.

The sane and business-like management of the extremely valuable forest estate of the Government of Burma is easy to appreciate from the latest annual report.

With 29,000 sq. miles of reserved forests and 94,000 sq. miles of unclassified forests, Burma is in possession of a splendid property, much of which bears large quantities of teak, one of the best timbers in the world. The future of the unclassified forests is one of the most pressing problems and it is a good thing that the examination of these forests, which are still potentially valuable over large areas, is engaging the earnest attention of the staff.

Out of the 29,000 sq. miles of reserved forests, no less than 25,000 have had, or are having, working plans prepared for them. This is a percentage which some other provinces might well try to emulate.

The plantations are stated to cover 130,000 acres, and 105,000 acres out of the total are teak plantations or have teak as the predominating species. It is believed that these plantations will prove a sound investment, especially as orders have been issued to give preference to teak on all suitable soils.

Forest Research in Burma will be separately reviewed. It is sufficient here to note that good progress was made in all the branches of research. The following remarks are worth quoting :—

“ The whole object of economic research is to explore and develop the possible uses of indigenous timbers and other forest produce. Up to date, however, the research work done in Burma has had but little effect on the development of commercial interest in the indigenous hardwoods other than teak, though signs of some awakening are apparent. This state of stagnation is largely due to the difficulty of competition with teak itself, which is a well-known timber of exceptionally high quality and which, in comparison with most of the other hardwoods of Burma, is relatively both abundant and easily extractable.

“ Nor has the country as yet appreciated the benefit of seasoning. The bulk of the provincial outturn of timber other than teak is utilized for house building and other rough local work for which almost any timber is used unseasoned and difficulty in obtaining timber of the desired species leads locally to the increasing use of timbers formerly considered to be unmarketable. Research into the possible uses of the various unknown hardwoods is unlikely, therefore, to pay directly ; but there is every reason to believe that it will pay indirectly. Under present conditions less than half of the timber growing in our mixed natural forests will repay the cost of extraction. Each species for which proved uses are developed adds to the percentage of marketable timber and improves the economy of extraction. Also the development of methods of seasoning and of other ways of increasing the durability of timber such as impregnation, offer a possible means of affecting some reduction in the pressure of the ever-growing demands on the timber output of the province which it would be shortsighted to neglect. There is, therefore, no reason to regret having started research into the possible uses of our hardwoods or to contemplate closing such research down until all species that exist in marketable quantities have been thoroughly tried out. Economy in expenditure on research can, however, be effected by confining attention to species of which a sustained supply is available and

"avoiding species that exist in negligible quantities or for which no sustained supply can be guaranteed."

A number of excellent pictures of wild animals, published with the report, indicate the interest which is now being taken by the Department in the preservation of the extremely interesting fauna of Burma.

Other pictures show a fine road bridge in Tharrawaddy, built by the Department, and mechanical method of extraction of hardwoods, by Messrs. Steel Brothers & Co., Limited.

ADMINISTRATION REPORT OF THE FOREST DEPARTMENT OF THE CENTRAL PROVINCES, 1928-29.

The position as regards the introduction of new Working Plans and amendments to the old ones appears to be satisfactory. Any definite results indicating the suitability of the uniform system or otherwise to the teak forests in the Central Provinces will be watched with interest.

It may be safest to place areas with good advance growth in P. B. I. but it may not be most economical. Other considerations *e.g.*, the average age and size of the crop likely to fetch best prices should also be considered.

The retention of a few seed-bearers in regeneration areas has been considered to be an unsuitable prescription. The main question appears to be whether the standards can fulfil the objects for which they were retained. Much depends also on the actual number retained and their distribution. Experience in the United Provinces seems to indicate that about 40 to 50 standards per acre should be reserved in the sal regeneration areas, after the main fellings.

The affairs of the Raipur Forest Tramway which is running at a loss have been thoroughly discussed by the Chief Conservator of Forests who has arrived at the conclusion that the diversion of a trade route and establishment of new markets will always take time and markets being essentially places of exchange, the new markets must have facilities for exchange *i.e.*, in the case of

timber markets of this province there must be shops selling cloth, hardware, etc. The Lalkua Forest Tramway in the United Provinces has repaid its capital cost in a few years. In respect of possessing shops for sales of cloth, hardware, even the railhead at Likma of the Raipur Project appears to suffer by comparison with the railhead at Machliban of the Lalkua Tramway. The primary cause of the Raipur Tramway not being a paying proposition so far, should be sought elsewhere than in the absence of hardware at Likma.

Road-making appears to be a great financial success. In these days of almost universal trade depression it is gratifying to read of financial undertakings in which a handsome dividend is always assured.

The financial results show increases of Rs. 3,64,174 in gross revenues and of Rs. 1,86,820 in expenditure in excess of the previous year. The total surplus of the year is about Rs. 14,00,000. Much of the success in the working during the year under review is due to late Mr. Stevens. It will not therefore be out of place to quote here the reference to the late Mr. E. R. Stevens by His Excellency the Governor of Central Provinces and Berar :—

"He was one of those many Englishmen who have given of their best to the country of their adoption; a good friend to all and a loyal servant of the State."

THE ELI WHITNEY FOREST.

A DEMONSTRATION OF FORESTRY PRACTICE.

BY RALPH C. HAWLEY AND WILLIAM MAUGHAN.

Yale University School of Forestry, Bulletin No. 27, 1930.

It may be that the Forest Officers of the United States of America are, as has often been alleged, not very great at getting work done and at improving their forests, but they can certainly produce beautiful reports.

The large pamphlet now under review has rarely been surpassed as handsome forest literature. Measuring twelve inches

by nine inches, the book contains fifty-six beautiful plates and several finely drawn and printed maps, and the cost, which must have been considerable, has been met mostly out of the Charles Lathrop Pack Foundation at Yale, one of the excellent and numerous endowments in which the American Universities are so rich.

The property is owned by the New Haven Water Company and covers 21,000 acres and the principal commercial hardwood species are the red, white, black and chestnut oaks, *Q. coccinea*, *Q. bicolor*, *Q. velutina*, *Q. montana*. Most of the timber goes to the market as lumber sleepers, piling and cordwood. It is stated that the owners were actuated by the desire to secure the best type of natural protection for the watersheds and reservoirs and they have wisely recognized that they can do this and at the same time run their forests as a commercial proposition.

At stating simple and obvious facts, American foresters are unexcelled and this report supplies many good examples of this idiosyncrasy.

It must be confessed that the illustrations, beautiful as they are, indicate for the most part that the work of bringing the area into full density and to the state of normal stocking is only just beginning.

EXTRACT.

ADMINISTRATION REPORT OF THE GOVERNMENT CINCHONA DEPARTMENT, MADRAS, FOR THE YEAR 1928-29.

The following is of interest:—

“General.—The Cinchona Department of Madras has been in existence for nearly seventy years and if the recommendations of the Royal Commission on Agriculture are given effect to, the absorption of this department in a Central department under the Government of India, may be due for record in the near future. In that time India has witnessed the formation of large cinchona plantations by private enterprise and, for a variety of reasons which need not be referred to here, the gradual withdrawal of the private planter until there are but a few hundred acres of cinchona not owned by the State. The world's demand for quinine has increasingly been supplied by the Island of Java until to-day quinine is a virtual monopoly of the Dutch. In India at least 60 per cent. of the quinine consumed is derived from Java grown bark and it is therefore not to be wondered at that the Royal Commission on Agriculture, in referring to the appalling

mortality from malaria in India, counselled the Government of India to take energetic action in opening new acres under cinchona, so that in time India can be self-supporting and in a position to reduce the price of quinine below the present controlled figure. The problem of correlating production and consumption must be faced before central control can be effective, but inasmuch as the aim of the Government of India in establishing a Central department would be the elimination of malaria throughout the Provinces and Indian States, willing co-operation can surely be expected from the Public Health authorities. But it is as well to emphasise that the formation of large cinchona plantations as recommended by the Royal Agricultural Commission, necessitates the expenditure of large amounts of capital and if a plentiful supply of cheap quinine is to be forthcoming, the active participation of the provinces in utilizing freely the quinine produced should be guaranteed in some manner before the Government of India can proceed with confidence. It is unlikely that conditions of growing cinchona exist anywhere in India as good as in Java and considering the upward trend in wages, which are believed to be higher than in Java, it may prove impossible to reduce the selling price below the present level. Still if India can only supply its own requirements of quinine at a price not higher than the imported drug, a great object will thereby be accomplished.

The strengthening of the scientific staff employed by Government is a recommendation which commends itself and particularly so if it is decided to invite private enterprise to share in the scheme of making India self-supporting. Since the cinchona tree is much more difficult to cultivate than tea or coffee it is unlikely that private capital will be attracted unless definite inducements are offered to the planter. Government will be expected to allot forest land, which experiment has determined as suitable for cinchona, at attractive rates and if past negotiations with representative planters form a criterion, assurances would be required of a minimum rate per unit of quinine to safeguard against loss. State assistance in the provision of selected seed would be required and the control of the acreage under cinchona, at least in the early stages, would remain in the hands of the Government so that the production of bark should be in relation to the probable demand for quinine. Granted that the scientific investigation on which the Royal Agricultural Commission lays such emphasis, is conducted with thoroughness and is rewarded with success, there appears no reason why the private grower should not be invited to assist in liberating India from its present dependence on foreign bark.

Treatments P. Pice packets.—For over thirty years there has been in existence a system of distributing quinine through the agency of the post offices in Madras Presidency. During the War the sales amounted to nearly 3,000 lb. of quinine sulphate per year but latterly there has been a falling off in demand until only about 2,000 lb. is annually disposed of. The question of reducing the issue price to stimulate demand has been under consideration for some time and a Committee was convened in the year, presided over by the Surgeon-General, to consider the question and make

recommendations. It was finally recommended to Government that the pice-packet system should be abandoned altogether and in its place the system of selling "Treatments" should be substituted. This latter system has been popular in Bengal for many years. By a "treatment" is meant a quantity of quinine in tablet form sufficient to allay an ordinary attack of malaria. In Madras the quantity of quinine required for a treatment has been calculated at 100 grains. If the recommendation is accepted by Government, it is intended to supply post offices with simple tubes containing 20 tablets of 5 grains each and to sell these at 5 annas per tube. This represents a considerable reduction in price compared with the present rate for pice-packets and it is hoped that the "treatment" system will prove popular. The cost of making suitable tubes and containers for "treatments" is relatively high, but if a Central department is formed in India it should be possible to institute a uniform "treatment" which can be issued even cheaper to the public."

PROBATIONERS FOR THE INDIAN FOREST SERVICE.

The Secretary of State for India announces that three appointments of Probationer for the Indian Forest Service will be made after interview by a Selection Committee in or about August next.

Candidates must be over 20 and under 24 years of age on the 1st May, 1930, must have obtained a degree or diploma in Forestry at a University of Great Britain or Ireland, and must possess such practical knowledge of Forestry as will enable them to take up duty as an Assistant Conservator of Forests without undergoing further training in Europe. Candidates are required to produce evidence that they have a fair knowledge of either German or French. Preference will be given to candidates who possess an Honours degree in Natural Science in addition to the above-mentioned qualifications.

Applications for appointment must be received not later than the 1st July, 1930, and must be made on a printed form obtainable from the Secretary, Services and General Department, India Office, London, S.W.1., from whom full particulars may also be obtained.

(The Times.)

MOSS ON TREES.

Mr. Gilbert Rogers asked to be allowed to say a few words on the subject of the effect of moss on trees. In the high level coniferous forests of the Himalayas it did contribute to their death. He then described how, in the hot weather (April or May) of 1890, when Forest Officer in charge of the Darjeeling Forest Division, he had to put out a forest fire which had crossed the Singalila Range of mountains from Nepal, between Sandakphu and

Phalut, at an elevation of about 12,000 feet, and entered a forest of the Himalayan silver fir (*Abies Webbiana*). The fir forest was over-mature, and many of the trees were unsound. Both stems and branches were much infested with moss, which at that time of the year was very dry. The fire set alight the moss on the lower part of the stems of the trees and ran up the stems into the crowns of the trees. The wind blew the burning pieces of moss from the crown of one tree to that of another, and a considerable number of trees were killed before the fire was extinguished.

The moss, of itself, did little or no damage to the trees under normal conditions, and is, in his opinion, only a proof of the great amount of moisture in the air during the greater part of the year, and especially during the monsoon, when the forests are almost always enveloped in the clouds, which at that time of the year are saturated with water vapour.

(Proceedings of the Linnean Society of London.)

MR. AUGUSTINE HENRY.

Professor Augustine Henry, late Professor of Forestry at University College, Dublin, who died at his house in Dublin yesterday afternoon, will go down to posterity as the joint author, with the late Henry Elwes, of "The Trees of Great Britain and Ireland," which was published in parts between 1906 and 1913, and must for long remain the standard work on the subject. His restrained and careful share in that fine work, however, was but the culmination of an earlier career, which, unique in its way, was as interesting botanically as it was important, for Henry was the *doyen* of the small group of adventurers who have explored the vegetation of Central and Western China, as well as the pioneer of the British group. That is no disparagement of Fortune, an earlier explorer whose lines in China were cast in different places.

Henry began his career as a physician—he was L.R.C.P., Edinburgh—and for his first post was attached for a year to the medical staff of the Chinese Imperial Maritime Customs at Shanghai. In 1882 he was appointed medical officer to the Customs station at Ichang, on the Yangtze, and it was during his seven years' service there that he began to explore the flora in the vicinity of the place, and laid the foundation of the collection of Chinese plants for which his name afterwards became famous among botanists and gardeners. China is the home of the *materia medica*, of which the great exponent, if not the originator, was the legendary Emperor, Shen-nung. According to tradition, he carried his interest in the subject to the length of having a glass window fitted into the wall of his stomach, so that the effect on the alimentary system of various herbs could be observed.

As a doctor Henry could hardly fail to be interested in the therapeutic value attached by the Chinese to the bulbs and roots and leaves of everyday plants, and it was the desire to investigate this subject which originally led him to begin collecting them. He wisely sent his first collection of Ichang specimens to Kew Gardens, where Thiselton Dyer received them with an appreciation which their novelty and importance warranted. Henry was encouraged to continue and extend his explorations, and having obtained six months' leave from his chief, Sir Robert Hart, in 1888, he spent half of it on a plant-hunting expedition in the mountains to the south-west of Ichang and the other half on a similar expedition in the highlands to the north-west of his station, across the Yangtze.

These journeys through parts of the province of Hupeh were mainly in botanically virgin country which extended to the eastern fringes of Szechuan, and the first, especially, was of absorbing interest. It was then that Henry saw the famous flowering tree *Davidia*, of which there are many examples in Britain now, thanks to the enterprise of Veitch, the Chelsea nurseryman, who sent a collector to China specially to gather the seed. Incidentally, this collector, E. H. Wilson, eventually became as famous as Henry. When examined at Kew, Henry's collection of Hupeh plants was found to contain about 500 new species of plants and 20 new genera.

After a year's leave at home, where he was received in botanical circles with a warmth which laid the foundation of life-long friendships, Henry returned to the administrative staff of the Customs service at Shanghai, and thereafter ceased to practise as a physician. He was soon transferred to Formosa, which had not then been ceded to Japan, and during his three years there he enriched our knowledge of Formosan plants by systematic exploration in the district of Takow, where he was stationed, later on publishing the first account of the flora of Formosa.

In 1896 Hart brought Henry back to China and stationed him at Mengtse, in Southern Yunnan, part of an area which, mainly through the botanizing activities of priests of the French foreign missions, was beginning to be known to European botanists as a floral paradise. Henry spent all his leisure in the collection of plants and sent home specimens of hundreds of rare and novel species. It was when he was plant-hunting in virgin forests in the mountains south of the Red River, in the extreme south-east corner of Yunnan, that he discovered the wild tea plant, which had never before been found out of Assam, and was therefore supposed to be confined to that province. Two years later found Henry as assistant in charge of the Customs depôt at Szemao, also in Southern Yunnan, whence he sent home another astonishing collection of plants.

In his collecting Henry was disinterested, and gave no thought to pecuniary reward of the commercial value of his finds. Like his great predecessor Delavay, his aim was discovery, and he sent home far more dried specimens of plants than roots or seeds. Hence many of his discoveries are

still unknown except as herbarium specimens, while others have been brought into cultivation by collectors who have rediscovered Henry's plants.

Henry's interest in trees and forestry had been so whetted by what he saw in Asia that when he returned home in 1900 (incidentally to find himself botanically famous) he determined to devote the rest of his life to arboriculture. To that end, when he was 45, he spent nearly two years at the School of Forestry at Nancy, and whenever he had the chance would travel far and wide in pursuit of his hobby. In 1907, while working with Elwes on the material for the book already mentioned, Henry was appointed Reader in Forestry at Cambridge University, where his demonstrations of the practical value of breeding trees on Mendelian lines long since justified themselves. In 1913 he was appointed Professor of Forestry in the College of Science, at Dublin, and he retained the Chair when the College was absorbed in the Irish National University, finally relinquishing it in 1926. Henry, who belonged to many learned societies, wrote voluminous papers on the subject next to his heart, and all that he wrote was worth reading, for his enthusiasm for his subject was tempered by a natural caution and a determination to write only of what he knew. That he knew more than most had long been the opinion of those qualified to judge.

Born on July 2, 1857, Henry came of an old Derry family and was an Irishman to the backbone. He had the delightful qualities of his race, including a never failing fund of enthusiasm and an innate sense of humour; his letters were a delight, and his conversation no less so. His first wife was Caroline Orridge, sister of the singer. She died not long after their marriage, and in 1908 he married the eldest daughter of Sir Lauder Brunton, the eminent physician.—(*The Times*.)

INDIAN FORESTER.

AUGUST 1930.

REPORT OF THE INDIAN STATUTORY COMMISSION,
VOLUME I, PARA 306, PAGE 279.

FOREST ADMINISTRATION.

Something must be said of the work of the Forest Service. In some provinces, the forests yield an important revenue to Government ; in Burma it is nearly 20 per cent. of the total provincial revenues. But apart from this they constitute a valuable economic asset to the community. It is an asset which could easily be frittered away and the pressure for a short-sighted exploitation of forest resources is strong. If the best use is to be made of them, long views must be taken. It is not enough that Government should have a right policy in the matter ; expert knowledge, professional enthusiasm and firmness in administration are essential in the controlling staff. From the nature of the work, defects in forest administration may not show their full effects for many years. The maintenance of the present standards of administration is, therefore, of great importance. The heads of Forest Departments in their evidence stressed the need for the maintenance of the European element in the Service and we were the more impressed by their view because the life of a forest officer, which has many attractions for young Englishmen, makes less appeal to the educated Indian than a career in any other service.

A RETROSPECT AND A PROBLEM FOR THE FUTURE.

The young forest officer who came out to India twenty years ago, fresh from his course of practical forest training in Europe, was generally wise enough to keep some of his first impressions to himself. But, if he had been told to say what features of Indian forest management astonished him most, he would probably have answered more or less as follows :—

- (a) In *Silviculture*, the great importance attached to mere forest protection and conservation and the neglect of methodical efforts to regenerate the forests.
- (b) In *Utilisation*, the almost religious observance of rules prohibiting the removal of any except decaying or over-mature trees of a few species that were held in some estimation, and the lack of interest taken in all the other species.
- (c) In *Organisation*, the immense areas of the executive charges and working circles, even a forest guard's beat being as a rule far larger than many a European forest division, and a single working circle often extending into several ranges.

Later on, having learnt something of the chequered history of the forests of India and having seen the miserable relics of some of the ruined private forests, he came to realise that the Forest Department's ultra-conservative, rigorously economising policy had been the only one possible in the past. He soon found himself in charge of a Division of anything from twenty to a hundred times the size of the European forest where he had been trained. Its mere size and variety, the joys of camp-life in a big forest district and the opportunities it afforded for sport were not bad compensations for the futility of trying to keep abreast of modern practice in his profession as he had been taught it. Before long he had probably forgotten the startling contrasts between Indian and European forestry, or had found it better for his peace of mind to accept them as inevitable consequences of the mysterious differences that are supposed to distinguish East from West.

However, a change was to come. In 1916, Troup's "*Note on some European Silvicultural Systems with suggestions for Improvement in Indian Forest Management*" drew the attention of the Forest Department to the disconcerting fact that the so-called "Selection System" and "System of Improvement Fellings," under which most of the Government forests of India and Burma had hitherto been managed, were not silvicultural systems at all, inasmuch as they made no provision for systematic regeneration. This was a pretty severe condemnation of Indian Working Plans. It may be doubted, however, whether it would have taken such rapid effect but for the war.

The war suddenly increased the demand for all the well-known Indian timbers. And the war created a new demand for other Indian timbers, the potential uses of which were already partly known in the Forest Economist's branch of the Forest Research Institute, although they had been generally disregarded by forest officers and the timber trade. The resulting heavier exploitation of the Government forests called for more intensive forest management and made provisions for systematic regeneration absolutely essential. These desiderata were carefully prescribed for in a series of new Working Plans, moulded on the best European models. The Government printing presses were kept busy, and an absurdly under-staffed Forest Department, obsessed for the time being with the magnitude of its vast resources, started off gaily on a semi-commercial career. In the course of a few years there came into being Conservators of Utilisation and Working Plans Circles, Silviculturists and Utilisation officers: and more recently the great new Forest Research Institute has been built, staffed and equipped at Dehra Dun.

Unquestionably all this development has had results of great benefit to the Forest Department and to the country generally. But, so far, it has been a lop-sided development, for the primitive organisation of the territorial executive charges still remains essentially much the same as it was in the days when originally designed for forests that were not managed under any silvicultural system. And, incidentally, as was only to be expected in a country where so much importance is attached to the written word,

the Forest Department has become perfectly organised for writing exhaustive reports on any forest subject whatever, while the consumption of pens, ink and paper in the divisional forest offices and range offices is something our predecessors of twenty years ago could only have dreamt of in their wildest nightmares. The first inevitable result of each development has been an increase in the local forest officer's office work.

Hinc illae lachrymae.—The purpose of this note is to advance the view that intensive forestry is utterly incompatible with our extensive executive charges and ever-rising tide of office work, and that the Forest Department cannot look for any further progress until it has faced this problem squarely and without prejudice.

Some of our recent Working Plans prescribe the systematic regeneration of enormous areas and a multitude of very necessary operations for tending and improving the crop in dozens of huge compartments each year. And many more trees have to be marked and felled than under the old Indian selection system. The success of such operations depends, as Working Plan Officers are careful to point out and as European experience has shewn, on the amount of personal attention devoted to them by the divisional forest officers and rangers. In other words the divisional forest officers and rangers of today ought to spend far more time in their forests* than their predecessors did. But, if they did, they would probably soon get sacked for letting their accounts, official correspondence and reports fall into arrears, and for neglecting a thousand and one other miscellaneous duties, all of which would be quite subordinate to forestry in Utopia, but not alas in India.

The difficulty does not arise in Europe, because, there, the executive charges are very small judged by our traditional Indian standards, and every forest officer is a practical working silviculturist. In India, however, the name "Silviculturist" is reserved for a few specialists, and the Department seems

* *Footnote.*—By "in their forests" means literally *in their forests* not merely on tours which may be largely taken up with travelling from one place to another along forest roads.

to be rapidly reconciling itself to a policy which makes it as difficult as possible for the local territorial forest officers to give adequate attention to silviculture.

Not till the man on the spot is allowed as much time as a French or German Forest Officer for getting to know all parts of his forest intimately and for watching closely the results of the work done in each compartment, can the Forest Department hope to solve the silvicultural problems that still baffle it in so many Indian forests.

It is perhaps feared that small executive charges would not immediately pay in India. In the more remote forests they might of course be an unnecessary expense. But the forests we now have under consideration are those for which our Working Plans prescribe intensive management, presumably because intensive management would pay. There must be many such forests in India, where the local demand for forest produce is as keen and the market prices very nearly if not quite as high as in Europe. Whereas, however, European forest officers, dealing with such small areas, are able to exploit their forests departmentally or by means of small contracts, and to sell most of their produce in very small lots at practically retail prices, the Indian forest officer has to be satisfied with the best prices he can get from the sale of huge lots, containing hundreds of thousands of standing trees, or from leasing out tracts of forests for periods of several years at a time.

Not till the Forest Department abandons such primitive methods of exploitation can it hope to take full advantage of the potentially expanding source of revenue that its forests unquestionably are.

Immediate reconstruction of the whole territorial organisation would not be practical politics in India. But that is no reason for retaining the anachronism everywhere. The time has surely come for making practical trials, in selected forests, of small executive charges on French and German models. The localities selected for such trials would of course be chosen in some of the forests for which our Working Plans Officers have already given

us counsels of perfection in the shape of up to date Working Plans bristling with prescriptions for intensive management.

The existing forest divisions, with their boundaries generally fixed by the limits of civil districts, have been primarily units of administration. As units of modern forest management they are becoming less and less satisfactory and will probably have to be gradually replaced by small ranges in charge of trained forest officers having their own budgets, time to supervise personally and authority, within certain limits, to sanction all works in their forests.

CATCHING OF A "MUSTH" ELEPHANT.

The following is a description of the catching of a *musth* timber elephant belonging to Messrs. Steel Brothers & Company, Limited:—

On Tuesday, March 25th, the position of Sein Balu was located on the banks of the Nammun Chaung above Nammun Camp, and the head elephant men selected a spot for the pit between the elephant and the camp, in a fairly open piece of jungle and on a jungle path. The elephant men then dug the pit about 10 feet long, 6 feet wide, and 10 feet deep. When the pit was finished a log was placed on each side of the pit to prevent anything coming along the path from going round the pit.

Very early the next morning, the elephant men cut light poles and bamboos and covered the pit with them, putting earth and teak leaves over the top. The figure of a man was placed on the opposite side of the pit from which Sein Balu was expected and a long piece of cane attached to the figure was held by one of the men so that the figure could be moved about to give it an appearance of life when Sein Balu appeared.

Sein Balu at this time was below the camp being brought up by his rider, who to bring the animal along the right road, resorted to the simple expedient of calling and showing himself, at which Sein Balu followed in the hopes of catching him. As soon as the pit was finished, word was sent that Sein Balu was coming, when all the spearmen climbed trees. The rider then came along

the path letting his elephant get nearer and nearer to him and about 50 yards from the pit Sein Balu charged, the rider ran round the pit and Sein Balu attempted to gore the figure. He put his front foot on the side of the pit and thus his hind feet went in first so that he fell much more lightly than he would have done had he fallen in head first. As soon as he had fallen in, the spearmen surrounded the pit to keep his head down, but Sein Balu turned completely round and got his front feet out, and if the number of spearmen (twelve) had been less, would have certainly climbed out. He tried to get out twice, but in the end was chained round the neck to a tree and a log, and a further log dragged across the pit to keep his head down. He was kept in the pit for four days, but looked little thinner for his ordeal afterwards. The reason he was caught so quickly and easily was undoubtedly because his one idea at the time was to kill his rider, and any one else he could get hold of.

A SHORT ACCOUNT OF THE KULU FOREST DIVISION.

BY W. E. FLEWETT, I.F.S.

The Kulu Forest Division lies in the Kulu Sub-division in the eastern portion of the Kangra District. The Sub-division is separated from the Kangra District by a chain of mountains, and approach to Kulu is in consequence of this chain long and circuitous. The main road from Pathankot (N. W. R.) after going through Palampur, takes a south-easterly direction and joins the Valley of the Beas in Mandi State. The road then keeps to the river throughout the rest of its course, taking a sharp bend with the river to the north at Oot, and continues in a northerly direction to Kulu.

Until May, 1928, Pathankot was the railway station for Kulu, but now that the new Kangra Valley Railway has been opened the rail-head has moved up to Joggindar-Naggar in Mandi State, a distance of 87 miles from Kulu. It is still, however, cheaper and more convenient to travel by motor lorry all the way from Pathankot, *via* Palampur and Mandi, 178 miles in all, the first day's journey of 135 miles being to Mandi where, there is a

dāk bungalow, the remainder of the journey to Kulu being completed next day. I must mention that many if not most of the lorries are suffering from the effects of wear and tear, patches of kerosene tin and string being much in use as a means of keeping the bodies from rattling asunder. The road is passable for motor-cars right up to Manali 24 miles north of Kulu and I have seen an Austin 7 three miles further. The regular lorry service, however, runs only to Kulu.

The climate of Kulu, with the exception of Kulu town itself which can be quite hot in the summer months, is delightful, and compares very favourably with the English climate. The rainfall at Kulu is about 40 inches and roughly half of this falls in the winter months. Snowfall commences at elevations above 6,000 feet in early December and continues till early March, but high up in the Valleys and in the high lying nullahs snow lies till well into April. English fruit grows well in most parts of the Valley and beautiful apples and pears can be obtained in the season. Last year apples and pears were sold by hawkers in the local bazaars at 3 or 4 for a pice and hundreds of maunds of apples are thrown away annually and buried by the fruit growers for manure.

The scenery is superb and probably is at its best in the early spring when the snow is still on the crests of the mountains and when the apricot trees, which are dotted everywhere about the valley, come into bloom. About the same time the elms flower and the alder trees which fringe the banks of the Beas and side streams burst into leaf. A little later there is the rhododendron with its masses of bright crimson flowers, and this is followed by the blue Iris. In the summer also there are violets, anemones, buttercups and wild strawberries in abundance. No greater contrast could be found to the hot, dusty and monotonous plains of the Punjab and those who cannot go to Europe for their leave would do well to try Kulu.

The rocks found in the Division are granites gneiss, mica schists, slates and shales. Red quartzite also occurs in considerable quantities in the Parbatti Valley.

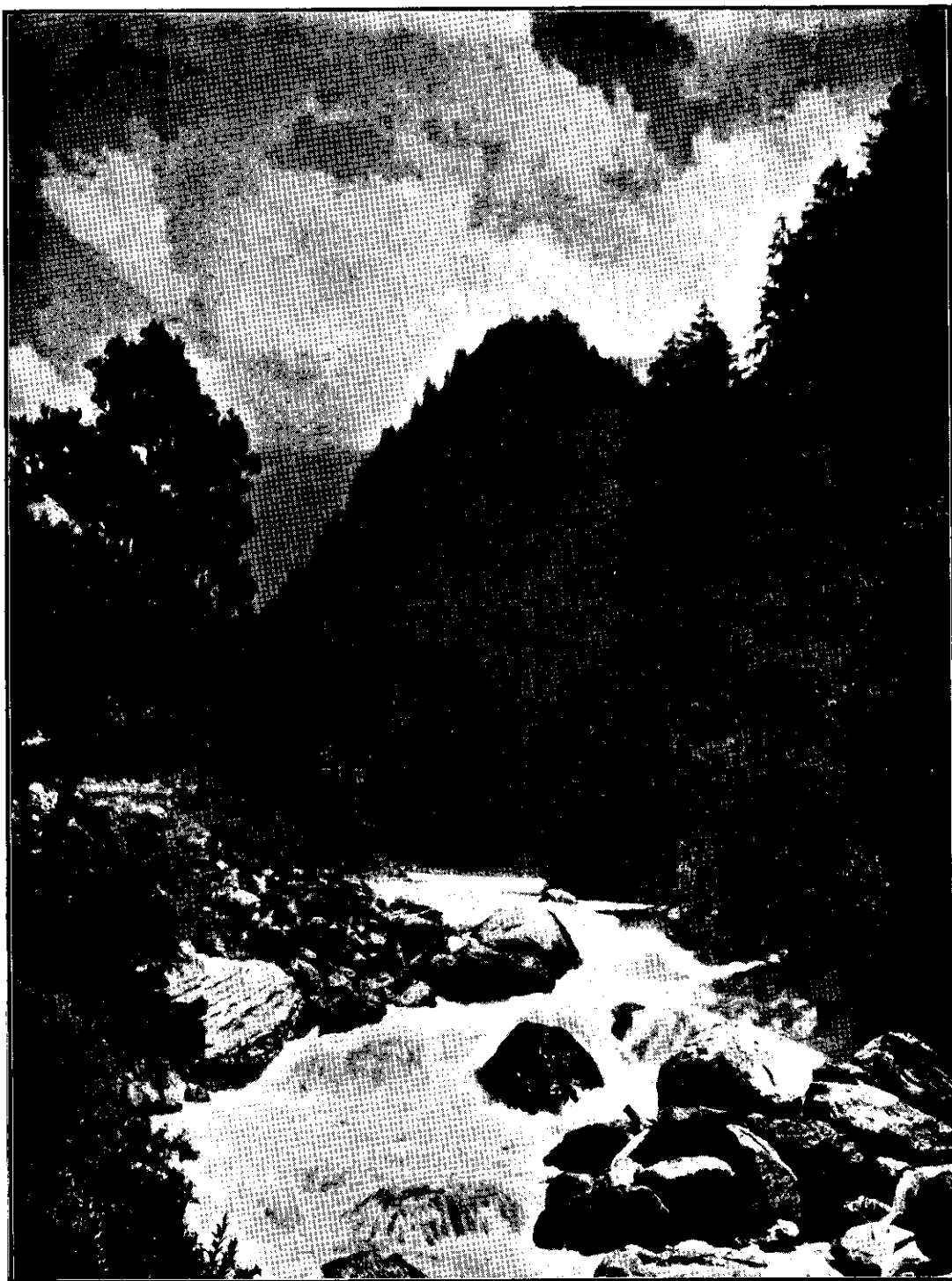


Photo by Dr. G. B. Archer, M.D. 1929.

The Parbatti River just below Polga, Kulu Forest Division.



Photo by Dr. G. B. Archer, M.D. 1929.

The Tos Nal. Kulu Forest Division, looking North.

Before 1921 the Kulu Forest Division included the forests of the Seraj Tahsil as well as those of the Kulu Tahsil, but to cope with the more intensive and extensive operations contemplated under the new Kulu Working Plan it was split into the two separate Kulu and Seraj Forest Divisions. These notes deal with the Kulu Division only.

The Kulu Division now includes the forests which cover the Valleys on both sides of the Beas river (and its tributaries) from its sources to its junction with the Hurla stream. It includes the valuable forests of the Parbatti and Hurla Valleys of the Rupi Estate. The forests total 958 square miles in all, but this figure includes enormous areas of ice, snow and rock, inaccessible and unproductive ground, and only 160 square miles are under regular working.

The principal species are the deodar, *kail* (*Pinus exelsa*), spruce and silver fir, and the forests are being worked under the well-known Kulu Working Plan (Trevor), by the shelterwood compartment system. With the introduction of this plan, arrangements were made for the closure of compartments to be taken up for regeneration and it became possible to carry out proper regeneration fellings, followed by debris burning and closure on lines which previous experiment had abundantly proved to be effective. Work is still being carried out on these lines and there now exist in Kulu regeneration areas equal in quality to the most successful and best kept regeneration areas in Europe.

After supplying the needs of the local inhabitants which are considerable, from 2 to 2½ lakhs c.ft. of sawn timber are floated down to the plains (224 miles) annually in the form of sleepers for the North-Western Railway and other sizes for the general market.

The duties of the Divisional Forest Officer also include a visit to Lahul annually for the forests of Lahul are also under his charge. Lahul is a tract of country of some 1,760 square miles situated to the north of Kulu, south of Kashmir, west of Spiti and east of Chamba. It is very much higher than Kulu, the lowest point at the exit of the Chenab river being about 9,000

feet, and the tract is snow bound for several months of the year.

The Lahul forests total only 2,680 acres in all, the principal species being *kail*, juniper and birch. The dwarf junipers *J. communis* and *J. recurva* are also common and are used for fuel. The forests as a whole are very poor but are very valuable both to the people for building timber and fuel, and for the maintenance of public works.

There is still a certain amount of big game shooting to be had in the Division, though now that it is so easy to get to Kulu one cannot expect that the quality of this sport will be maintained. *Ibex* are obtainable in Lahul and Spiti, but there are few now left in the Beas and Parbatti watersheds. Thar and goral are to be had, but the thar is heavily poached. Serow (*Nemohedus bubalinus*) are plentiful in the more remote forests in the Parbatti and Hurla Valleys, and there are also red bear and burrhal to be had on the high lying ground above Pulga.

The small game shooting is excellent, kalij and kokhlas pheasants can be had in abundance, the monal is also plentiful and the chir pheasant and tragopan are also available. Chakor are very numerous in the side valleys, and provide excellent sport.

Woodcock still come down to the low lying *bihals* (alluvial lands along the banks of the river) in the winter in considerable numbers, but this sporting bird is rapidly being shot out. Fortunately when flushed they do not sit in the trees, but the local "sportsmen" seem to be able to get them on the ground.

The Beas and its tributaries between Kulu and Manali provide very good trout-fishing, the fish running up to 2-3 lbs., but they do not average more than about $\frac{1}{2}$ - $\frac{3}{4}$ lb. each. Between Katrain (mile 12 above Kulu) and Manali (mile 24) the fish increase in size but are much harder to catch. In the higher reaches of the river also one gets a rainbow trout occasionally. Although the river is not a good fly-fishing stream as it runs too fast and there are very few pools with any still water, the trout will take the fly readily. Medium sized lake flies are the best, the Coachman, Teal and red, Teal and green, Grouse and claret,

Coch-y-bondhu, the "Worm-fly," Jock Scott and Silver Doctor all being taking flies. While the trout prefer some flies to others they are nothing like so fastidious as the trout are at home and fish can be caught with almost any usual pattern of lake fly. They will also take the natural fly but it is not a suitable river for the natural fly neither is it for the dry fly because the broken water makes it impossible to see the rises except when the fish are feeding voraciously. The evening between sunset and darkness is the best time, then the early morning, but fish can also be caught at other times of the day.

March, April and the first week of May are the best months to come up to fish. After that the snow water begins to come down and fly fishing becomes impossible. The water clears again about the 15th September and the fly fishing is good again up to the end of October when the season closes.

When the trout are not moving to the fly, fish can generally be caught with a worm, and one is more or less limited to worm fishing between the middle of May and the middle of September.

Fishing licenses cost Rs. 20 per month per rod and are issued by the *Sub-Divisional Officer, Kulu*.

The Division is well supplied with bungalows and a good deal of it can be seen without tents. Stores can be obtained in Kulu, but are very expensive and it is cheaper to obtain them from the plains. A limited supply of milk can be obtained in most parts of the Division, but a good supply of eggs should be carried. Vegetables are very difficult to obtain anywhere in Kulu. Sheep can generally be obtained at prices varying from Rs. 5 to Rs. 9 per animal. Transport mules can be easily arranged and cost Re. 1-4-0 day, halts at half rates.

**SACCHARUM ARUNDINACEUM RETZ. AND
S. PROCERUM ROXB.**

BY R. N. PARKER, I.F.S., FOREST BOTANIST.

These two grasses although usually considered synonymous seem to be distinct species though not easily separated in the herbarium. Both have been cultivated for many years in Dehra

Dun and one obvious distinction between them is their season of flowering. *Saccharum arundinaceum* flowers at the end of the rainy season, *S. procerum* in January by which time *S. arundinaceum* has shed its seeds and the panicle has completely broken up. The leafy stems in *S. arundinaceum* are much taller than those of *S. procerum*. Plate 33 shows a clump of *S. procerum* cultivated in Dehra Dun. A clump of *S. arundinaceum* has been figured by Hole in Ind. For. Mem. Vol. I, part 1, plate 22.

The leaves of *S. arundinaceum* are considerably broader than those of *S. procerum* and they are villous at the base only, whereas in *S. procerum* the hairs extend up the leaf for about 10 cms. especially along the sides of the midrib. In leaves on vigorous leafy culms of *S. arundinaceum* the midrib occupies scarcely one-third of the width of the leaf at the base and consequently the strip of green blade on either side is broader than the pale midrib. In *S. procerum* the midrib at the base occupies more than half the width of the leaf, the strip of green blade on either side of the midrib being reduced to considerably less than the width of the midrib. This character readily separates the two species when growing but in dried specimens is difficult to observe owing to the curling of the leaf margins. Moreover in herbarium specimens the leaves shown are usually the reduced ones on flowering culms and not the full sized leaves. The general look of specimens of the two grasses is different. *S. procerum* has a looser and more silky panicle than *S. arundinaceum*. In the flowers there seems to be no difference except that in *S. arundinaceum* glume IV has a mucro 1 mm. long the tip of which is as long as II whereas in *S. procerum* glume IV has a mucro .5 mm. long and is slightly shorter than glume II. This however amounts to little and is probably not very constant.

The best distinctions seem to be as follows taking the central portion of the racemes :—

S. arundinaceum Retz. Joints 3.5—4 mm. long; pedicels 2—2.5 mm.; sessile spikelets 2.5—2.7 mm. long.

S. procerum Roxb. Joints 6—7 mm. long; pedicels 2.5—3.5 mm.; sessile spikelets 3—4 mm. long.



A clump of *Saccharum procerum* cultivated in Dehra Dun.

As regards the names for these two grasses Hole when preparing his account of some Indian Forest Grasses for Ind. For. Mem. Vol. I examined what is believed to be the type of Retzius in the British Museum and has left excellent notes on it and on other specimens which exactly match it from which it appears that only the following specimens are known :—Koenig, cultivated near Tranquebar. Also a specimen "on banks of watercourses on rich moist alluvial soil of Tanjore." Drummond 3,006 (this according to the label on the sheet in Herb. Dehra came from a garden in Karnal, Punjab). A specimen from Woodrow from a Bombay garden. Several specimens from cultivated plants in Dehra Dun. It appears, therefore, that with the exception of the Tanjore specimen which may be from a wild plant, *S. arundinaceum* is only known as a cultivated plant. If wild anywhere in India the south of the Madras Presidency seems the most probable locality. In the neighbourhood of a plot of *S. arundinaceum* cultivated in Dehra Dun a considerable number of natural seedlings have appeared in the last few years whereas *S. procerum* shows no tendency to spread naturally.

S. procerum Roxb. is common in Bengal, Assam and Burma. Roxburgh has left an excellent unpublished coloured drawing of it, so there is no doubt as to the plant he named.

RESISTABILITY OF INDIAN TIMBERS TO WHITE- ANT ATTACK.

A further inspection report is now available on the experiments being conducted at Forest Research Institute to test the comparative resistability of untreated Indian woods to white-ant and fungus attack under ground. This inspection report is reproduced for the information of readers. The tests of the species listed in Table I below have now been completed and an attempt has been made to arrange these species into groups according to their durability.

Species still under test are listed in Tables II (a) and II (b).

The previous inspection report will be found in the "*Indian Forester*" Volume LV, July 1929.

TABLE I—COMPLETED TESTS.

Species.	Locality.	MAXIMUM LIFE.	MINIMUM LIFE.	PROBABLY AVERAGE LIFE.
		All rejected in	First rejected after	50% or more rejected in
<i>Dipterocarpus pilosus</i> ...	Assam ..	46 months	29 months	34 months.
<i>Bauhinia retusa</i> ...	Dehra Dun ...	38 "	15 "	22 "
<i>Dipterocarpus turbinatus</i> ...	Burma ...	38 "	29 "	29 "
<i>Castanopsis Hystrix</i> ...	Assam ...	38 "	38 "	38 "
<i>Stephegyne diversifolia</i> ...	Burma ...	38 "	9 "	24 "
<i>Abies Pindrow</i> ...	Dehra Dun ..	33 "	14 "	33 "
<i>Mangifera indica</i> ...	Bihar and Orissa	33 "	23 "	23 "
<i>Terminalia pyrifolia</i> ...	Burma ...	32 "	18 "	23 "
<i>Dillenia indica</i> ...	Assam ...	29 "	20 "	29 "
<i>Fraxinus floribunda</i> ...	Kashmir ..	29 "	6 "	6 "
<i>Lagerstroemia tomentosa</i> ...	Burma ...	29 "	15 "	29 "
<i>Vateria indica</i> ...	Madras ...	28 "	19 "	28 "
<i>Alstonia scholaris</i> ...	..	28 "	14 "	19 "
<i>Anthocephalus Cadamba</i> ...	Assam ...	23 "	9 "	14 "
<i>Cullenia excelsa</i> ...	Madras ...	23 "	9 "	14 "
<i>Cryptocarya amygdalina</i> ...	Assam ...	23 "	3 "	9 "
<i>Machilus Gamblei</i> ...	Hamiltongunj...	23 "	4 "	23 "
<i>Planchonia andamanica</i> ...	Assam ...	23 "	18 "	23 "
<i>Stereospermum chelonoides</i> ...	Assam ...	23 "	18 "	23 "
<i>Dillenia pentagyna</i> ...	Bengal ...	20 "	12 "	20 "
<i>Acer Campbellii</i> ...	Darjeeling ...	14 "	6 "	6 "
<i>Canarium euphyllum</i> ...	Andamans ...	14 "	7 "	7 "
<i>Parrotia Jacquemontiana</i> ...	Punjab ...	14 "	7 "	7 "
<i>Terminalia Chebula</i> ...	Burma ...	14 "	9 "	14 "
<i>Garuga pinnata</i> ...	Bihar and Orissa	13 "	8 "	13 "
<i>Odina Wodier</i> ...	United Provinces	13 "	13 "	13 "
<i>Bombax malabaricum</i> ...	Dehra Dun ...	< 12 "	< 12 "	< 12 "
<i>Cryptomeria japonica</i> ...	Bengal ...	< 12 "	< 12 "	< 12 "
<i>Sterculia campanulata</i> ...	...	10 "	4 "	4 "

< indicates "less than".

The tabulation according to Table I, in order of the maximum life is probably misleading, since the variables operating are numerous and involved. A retabulation is given below in which the timbers are grouped and any finessing in the order of durability for individual timbers is omitted.

Group I.—*Non-durable* timbers more than 50 % of which are destroyed in 12 months. Perishable, extremely liable to attack :—

Acer Campbellii.
Bombax malabaricum.
Canarium euphyllum.
Cryptocarya amygdalina.
Cryptomeria japonica.
Fraxinus floribunda.
Parrotia Jacquemontiana.
Sterculia campanulata.

Group II.—*Non-durable* timbers more than 50 % of which are destroyed in 13—18 months. Liable to attack :—

Anthocephalus Cadamba.
Cullenia excelsa.
Garuga pinnata.
Odina Wodier.
Terminalia Chebula.

Group III.—*Non-durable* timbers more than 50 % of which are destroyed in 19—24 months :—

Alstonia scholaris.
Bauhinia retusa.
Dillenia pentagyna.
Machilus Gamblei.
Mangifera indica.
Planchonia andamanica.
Stephegyne diversifolia.
Stereospermum chelonoides.
Terminalia pyrifolia.

Group IV.—*Moderately durable* timbers more than 50 % of which are destroyed in 25—30 months :—

Dipterocarpus turbinatus.
Dillenia indica.
Lagerstroemia tomentosa.
Vateria indica.

Group V.—Moderately durable timbers more than 50 % of which are destroyed in 31—36 months:—

Dipterocarpus pilosus.

Abies Pindrow.

Group VI.—Semi-durable timbers more than 50 % of which are destroyed in 37—42 months.

Castanopsis Hystrix.

TABLE II(a).

Uncompleted tests arranged in order of time ; some class A remaining.

A—Heartwood not attacked by white-ants or fungus, or only slightly attacked by either or both of them.

B—Heartwood moderately or badly attacked.

R (W)—Number removed mainly owing to white-ant attack.

R (F)—Number removed mainly owing to fungus attack.

R (W & F)—Number removed owing to destruction by white-ants and fungus.

Serial Number.	Number of specimens.	Species.	Period under test (in months.)	A.	B.	R.	REMARKS.
1	1 to 6	Anogeissus acuminata.	46	1	2	2 W. ...	One stick removed from B for use.
3	13 to 18	Bursera serrata ...	46	3	3	...	From Burma.
8	43 to 48	Terminalia tomentosa.	46	5	..	...	One stick missing.
12	67 to 72	Eugenia kanarensis	46	2	...	4 W & F	
15	85 to 90	Shorea Talura ...	42	1	5	...	
17	97 to 102	Terminalia Oliveri	42	2	1	3 W & F	

Serial Number.	Number of specimens.	Species.	Period under test (in months).	A.	B.	R.	REMARKS.
21	121 to 126	<i>Albizzia procera</i> ...	42	3	1	2 F ...	From Assam.
24	139 to 144	<i>Terminalia Manii</i>	41	1	4	1 W & F	Kiln-seasoned.
26	151 to 156	<i>Dalbergia Sissoo</i> ..	41	3	3	...	Do.
27	157 to 162	<i>Lagerstroemia microcarpa</i> .	41	5	...	1	Do.
28	163 to 168	<i>Lagerstroemia microcarpa</i> .	41	4	2	...	Air-seasoned.
30	175 to 180	<i>Terminalia Arjuna</i>	38	6	...	...
31	181 to 186	<i>Lagerstroemia parviflora</i> .	38	4	1	1 F ...	
32	187 to 192	<i>Ougeinia dalbergioides</i> .	38	5	1	...	
33	193 to 198	<i>Dalbergia Sissoo</i> ...	38	6	...	...	Sap eaten up in all the cases.
34	199 to 204	<i>Dalbergia latifolia</i>	38	6	...	...	Do.
36	211 to 216	<i>Parashorea stellata</i>	38	4	2	...	
40	235 to 240	<i>Pterocarpus dalbergioides</i> .	37	6	...	...	Slight fungus attack.
46	271 to 276	<i>Artocarpus Chaplasha</i> .	33	3	3	...	
47	277 to 282	<i>Altingia excelsa</i> ...	33	4	...	2 W & F	Sap all destroyed but heart sound.
49	289 to 294	<i>Grewia tiliifolia</i>	33	1	5	...	
50	295 to 300	<i>Hardwickia binata</i>	33	6	...	...
51	301 to 306	<i>Albizzia procera</i> ...	33	2	4	...	From Bihar and Orissa.
52	307 to 312	<i>Eugenia Jambolana</i>	33	5	...	1 Dry rot.	
54	319 to 324	<i>Dipterocarpus indicus</i> .	33	3	3	...	

Serial Number.	Number of Specimens.	Species.	Period under test (in months).	A.	B.	R.	REMARKS.
57	337 to 342	<i>Terminalia belerica</i>	32	1	1	4 W & F	From Bihar and Orissa.
60	355 to 360	<i>Poeciloneuron indicum.</i>	32	1	5	...	
61	361 to 366	<i>Bursera serrata</i> ...	32	4	1	1 W & F	
64	379 to 384	<i>Schleichera trijuga</i>	32	3	3	...	
65	385 to 390	<i>Bassia latifolia</i> ...	32	3	2	1 W & F	
67	397 to 402	<i>Cedrela serrata</i> ...	31	1	5	...	
69	409 to 414	<i>Calophyllum Wightianum.</i>	30	5	1	...	
70	415 to 420	<i>Xylia dolabriformis</i>	30	3	3	...	
71	421 to 426	<i>Cedrus Deodara</i> ...	30	4	2	...	
72	427 to 432	<i>Mesua ferrea</i> ...	30	6	...	...
74	439 to 444	<i>Duabanga sonneratioides.</i>	30	1	2	3 W.	Sap completely destroyed.
76	451 to 456	<i>Albizzia Lebbeck</i> ...	30	4	2	...	
77	457 to 462	<i>Eugenia Gardneri</i>	30	4	2	...	
78	463 to 468	<i>Dichopsis elliptica</i>	30	3	3	...	
80	475 to 480	<i>Diospyros Melanoxylon.</i>	29	2	...	4 W & F	
81	481 to 486	<i>Tectona grandis</i> ...	29	5	1	...	
84	499 to 504	<i>Shorea robusta</i> ...	29	6	...	...
85	505 to 510	<i>Pinus excelsa</i> ...	29	2	3	1 W	
86	511 to 516	<i>Kaya assamica</i> ...	28	1	4	1 W	
88	523 to 528	<i>Chloroxylon Swietenia.</i>	27	1	5	...	
89	529 to 534	<i>Calophyllum tomentosum.</i>	27	4	2	...	
90	535 to 540	<i>Pterocarpus Marsupium.</i>	26	3	3	...	

Serial Number.	Number of Specimens.	Species.	Period under test (in months).	A.	B.	R.	REMARKS.
91	541 to 546	<i>Artocarpus hirsuta</i>	26	3	3	...	From Madras.
92	547 to 552	<i>Homalium tomentosum.</i>	26	5	1	...	
93	553 to 558	<i>Dipterocarpus alatus.</i>	26	5	1	...	
94	559 to 564	<i>Heterophragma adenophyllum.</i>	25	6	...	...
96	571 to 576	<i>Messua ferrea</i> ...	25	6	...	...
97	577 to 582	<i>Phoebe Hainesiana</i>	24	5	1	...	
101	601 to 606	<i>Castanopsis tribuloides.</i>	24	6	...	...
103	613 to 618	<i>Cleistanthus collinus.</i>	24	6	...	...
104	619 to 624	<i>Dalbergia Oliveri.</i>	24	6	...	...
105	625 to 630	<i>Dalbergia paniculata.</i>	24	4	2	...	
106	631 to 636	<i>Dysoxylum binectariferum.</i>	24	6	...	...
107	637 to 642	<i>Eriolaena Candollei.</i>	24	5	1	...	
108	643 to 648	<i>Gluta tavoyana</i> ...	24	6	...	...
109	649 to 654	<i>Gluta travancorica</i>	24	5	...	I F	
110	655 to 660	<i>Hopea odorata</i> ...	24	3	3	...	
111	661 to 666	<i>Hopea parviflora</i>	24	6	...	...
112	667 to 672	<i>Heritiera minor</i> ...	24	3	3	...	
114	679 to 684	<i>Lagerstroemia hypoleuca.</i>	24	6	...	...
115	685 to 690	<i>Melanorrhoea usitata.</i>	24	6	...	...
116	691 to 696	<i>Pentace burmanica</i>	24	5	1	...	

Serial Number.	Number of Specimens.	Species.	Period under test (in months).	A.	B.	R.	REMARKS.
118	703 to 708	Soyimida febrifuga	24	6	...	...
123	733 to 738	Shorea obtusa ...	21	6	...	...
124	739 to 744	Pentacme suavis...	21	6	...	...
125	745 to 750	Dysoxylum matabaricum.	18	6	...	...
126	751 to 756	Casuarina equisetifolia.	18	1	3	2 W & F	
127	757 to 762	Dipterocarpus kerrii.	18	2	4	...	
128	763 to 768	Schima Wallichii	14	6	...	...
130	775 to 780	Holoptelea integrifolia.	14	5	1	...	
131	781 to 786	Hymenodictyon excelsum.	14	1	5	...	
135	805 to 810	Calophyllum elatum.	12	6	...	...	Sap eaten up.
137	817 to 822	Berrya Ammonilla	11	4	2	...	
139	829 to 834	Aegle Marmelos ..	9	6	...	...
140	835 to 840	Quercus lineata ...	9	6	...	...
141	841 to 846	Quercus lamellosa	9	6	...	...
142	847 to 852	Dipterocarpus Griffithii.	7	5	1	...	
143	853 to 858	Chickrassia tabularis.	7	6	...	...
144	859 to 864	Michelia montana	7	6	...	...
145	865 to 870	Amoora Wallichii	2	6	...	...

TABLE II(b).

Uncompleted tests arranged in order of time; no class A remaining.

A—Heartwood not attacked by white-ants or fungus, or only slightly attacked by either or both of them.

B—Heartwood moderately or badly attacked.

R(W)—Number removed mainly owing to white-ant attack.

R(F)—Number removed mainly owing to fungus attack.

R(W & F)—Number removed owing to destruction by white-ants and fungus.

Serial Number.	Number of specimens.	Species.	Period under test (in months).	A.	B.	R.	REMARKS.
14	79 to 84	<i>Dipterocarpus tuberculatus</i> .	48	...	1	5 W & F	
7	37 to 42	<i>Shorea assamica</i> ...	46	...	3	3 W & F	
9	49 to 54	<i>Bischofia javanica</i>	46	...	1	5 W & F	
11	61 to 66	<i>Terminalia Chebula</i> .	46	...	3	3 W & F	From Burma.
23	133 to 138	<i>Terminalia paniculata</i> .	41	...	6	...	Kiln-seasoned.
25	145 to 150	<i>Adina cordifolia</i> ..	41	...	1	5 W & F	Do.
35	205 to 210	<i>Terminalia procera</i>	38	...	3	3 W & F	
37	217 to 222	<i>Adina cordifolia</i> ...	38	...	1	5 W & F	Rejection mainly due white ant attack.
41	241 to 246	<i>Terminalia bialata</i>	35	...	4	2 W & F	
42	247 to 252	<i>Albizzia lucida</i> ...	33	...	2	4 W & F	
43	253 to 258	<i>Eugenia praecox</i> ...	33	...	1	5 W & F	
44	259 to 264	<i>Crypteronia paniculata</i> .	33	...	2	4 W & F	
56	331 to 336	<i>Picea Morinda</i> ...	33	...	1	5 W & F	
59	349 to 354	<i>Albizzia stipulata</i>	32	...	5	1 W & F	

Serial Number.	Number of specimens.	Species.	Period under test (in months).	A.	B.	R.	REMARKS.
62	367 to 372	Boswellia serrata...	32	...	1	5 W & F	Air-seasoned.
63	373 to 378	Adina cordifolia ..	32	...	1	5 W & F	
66	391 to 396	Stephegyne parvifolia.	32	...	1	5 F	
68	403 to 408	Cedrela Toona ...	30	...	3	3 W & F	
73	433 to 438	Cinnamomum Cecdodaphne.	30	...	3	3 W & F	
82	487 to 492	Diospyros pyrrocarpa.	29	...	1	5 W & F	
95	565 to 570	Dipterocarpus obtusifolius.	25	...	6	...	
98	583 to 588	Acrocarpus fraxinifolius.	24	...	6	...	
99	589 to 594	Anogeissus latifolia	24	...	4	2 W & F	
113	673 to 678	Juglans regia ...	24	...	2	4 W & F	
119	709 to 714	Bombax insigne...	24	...	1	5 W	
120	715 to 720	Pinus longifolia...	24	...	5	1 W & F	
121	721 to 726	Michelia Cathcartii	22	...	2	4 W & F	
122	727 to 732	Machilus spp. ...	22	...	6	...	
129	769 to 774	Parishia insignis ..	14	...	3	3 W & F	
132	787 to 792	Polyalthia fragrans.	14	...	6	...	
134	799 to 804	Morus alba ...	12	...	6	...	
138	823 to 828	Swintonia floribunda.	11	...	6	...	

BIRTHDAY HONOURS' LIST.

We offer our congratulations to Mr. Bhusan Chandra Das, Extra Assistant Conservator of Forests, Bihar and Orissa, on receiving the title of RAI SAHIB.

REVIEWS.

**PROGRESS REPORT ON FOREST ADMINISTRATION
IN BENGAL, 1928-29.**

The annual tilting match between the Bengal Conservators and the Bengal Local Government is always entertaining and fruitful in subjects for reflection. The particular gem this year is the Local Government's reply to the complaint on the part of the Conservators that funds are not given to the department with sufficient liberality, and the suggestion for the separation of the forest budget as has been done in the case of the railways in India. It is as follows :—

"Most of the schemes submitted for inclusion in the budget of 1928-29 have again found their way into the schedules for 1929-30, but their ultimate inclusion in the Budget as presented to the Legislative Council must, now as always, depend upon two permanent factors which weigh with business firms as well as Government, the ability to provide the necessary finance, especially in respect of recurring expenditure and the relative importance of particular schemes.....

"The proposal that the Forest budget should be separated from the Provincial budget implies that the development of the forests of Bengal should be given preferential treatment over the manifold activities of Government in other spheres, *e.g.*, education and public health. It is more than doubtful whether there would be public support to any scheme which subordinated immediately essential interests such as the education and health of the people to the expansion of forest revenue." (Italics are ours.)

Of course a business firm does not often have to run a charitable organisation (education and public health) in conjunction with a profit making concern, but to take an improbable illustration it would not be encouraging to the shareholders of a business concern which had to run a hospital and a rubber estate if money for planting and tapping the rubber were cut down to provide funds for the hospital. Surely even the Secretarial

brain should be able to realise that schemes for the expansion of forest revenue, if sound, must in the end make increasing funds available for education and public health. The starving of the Forest Department can only lead to a lower surplus which is what the Local Government is most intimately concerned with and we would welcome any suggestions which would lead to the separate financing of forests and allow of a consideration of forest expenditure on its own merits and not in conflict with the claims of non-productive departments.

The Conservators devote a long paragraph in the Foreword to the activities of the audit by the Accountant-General's staff. They comment on the fact that, while the audit has disclosed numerous errors and omissions to observe accounts rules, nothing serious resulting in the loss of revenue has occurred. The amount of work imposed by audit is tremendous.

"In one division alone, keeping up the register of sanctioned works in accordance with instructions issued recently by the audit staff necessitates about 2,000 entries a month." This will necessitate increase of staff and non-productive expenditure. We wonder greatly if all this fuss about petty items of procedure is worth while. The most expensive brand of red tape is usually procurable from the Accountant-General.

The Foreword rightly stresses the valuable work being carried out by the Provincial Silviculturist and points out that such work although it brings no early increase in profits will undoubtedly lead to increased profits in the future.

With regard to the report itself we are pleased to note that it is now printed in a more attractive form and is illustrated.

Area of forest.—The area of reserved forest has been increased during the year by 1,181 square miles to a total of 6,462 square miles or 8.42% of the total area of the Presidency. This may appear a small percentage but a glance at the map of the Presidency given at the end of the report will show the concentration of forest areas in North Bengal, the Sundarbans and Chittagong, with the whole of Central Bengal entirely devoid of

forests. (It seems a pity that colours were used so sparingly in this map that headquarters of Circles and Divisions as well as the boundaries of Districts and Divisions cannot be distinguished from the reserved forests.)

Working Plans.—6,206 square miles or 96% of the reserved forests of the Presidency are under working plans and 4,170 square miles were under revision during the year.

Regeneration.—An interesting table is given in para 43 to show the areas regenerated during the year as compared with the areas prescribed under Working Plans in the Northern Circle. This shows that 855 acres or 44% of the area to be replanted with sal (*Shorea robusta*) and *champ* (*Michelia Champaca*) and 1,609 acres or 36% of the area prescribed under all working circles were regenerated during the year. In the Southern Circle, progress is not so rapid and only 482 acres out of 3,444 acres prescribed or 14% were regenerated. Good progress has been made in the Chittagong Hill Tracts with teak and *gamari* (*Gmelina arborea*), but elsewhere the planting is still in an experimental stage with evergreen *dipterocarps* such as *D. turbinatus* and *Hopea odorata*. Line sowings of these species under the shade of *boga medeloa* (*Tephrosia candida*) are promising. The fact that thinnings in a 12-year-old plantation of teak and *gamari* in the Chittagong Hill Tracts, which had cost Rs. 30 per acre in formation and tending, sold for Rs. 44 per acre illustrates the great future value of these plantations. The total area of plantations in Bengal is 23,287 acres.

Outturn.—There was a considerable decrease in the outturn of timber from 22,150,293 cubic feet in 1927-28 to 18,506,152 cubic feet during the year. It is rather surprising to find that *gangwa* (*Excaecaria Agallocha*) contributes nearly 40% of the total outturn of timber from the Presidency. About 15½ million cubic feet out of the total outturn 18½ million cubic feet of timber is obtained from the Sundarbans.

Financial results.—The following statement gives figures and percentages of the main heads of the financial statement compared

with the figures for 1927-28 and the averages for the five preceding years :—

	1928-29.	1927-28.	Average for five years 1922 to 1927.
	Lakhs.	Lakhs.	
Gross Revenue ...	31·18	33·49	26·05
Expenditure ...	16·82	17·02	13·73
Surplus ...	14·36	16·47	12·32
Percentage of surplus to gross revenue ...	46%	49%	47%

The results of the year are due more to the slump in timber than to any other factor. The outturn from the Sundarbans provides 8·79 lakhs or 28% of the total revenue of the Presidency and 5·52 lakhs or 38% of the surplus. The report emphasises that the drop in revenue in the Sundarbans is "not for lack of demand, but because uncontrolled fellings, combined with "wasteful utilization have made it difficult for purchasers to "obtain what they require from places easy of access". The delay in financing the scheme for the formation of Ranges in the Sundarbans to ensure better control, due to lack of funds, is all the more deplorable.

The report closes with a review of the Forest Administration in Bengal for the quinquennium 1924 to 1929. This review is rather featureless. The only matter of real interest is a comparison of the average financial results during the quinquennium with those for the previous period 1919 to 1924.

They are as follows:—

	1919 to 1924.	1924 to 1929.	Increase.
	Lakhs.	Lakhs.	Lakhs.
Revenue ...	20·45	29·85	9·40
Expenditure ...	11·79	15·55	4·76
Surplus ...	8·66	14·30	5·64

This shows a considerable increase, more especially in the surplus, and the Local Government would do well to note that this increase so far from being due to a decrease in expenditure has resulted from an increase of over 4½ lakhs in expenditure.

ADMINISTRATION REPORT OF THE FOREST DEPARTMENT, MADRAS PRESIDENCY, 1928-29.

Although no striking developments are recorded during the year under review, steady progress appears to have been made and it is satisfactory to note that there was an increase in the gross and nett revenue, with a surplus of 13.09 lakhs which is a distinct improvement on that of any year since 1919-20.

A brief review is given of the experimental work which has been carried out in respect of the intensive exploitation of the evergreen forests on North American lines. As the result of this review it has been decided to close down these operations together with the Olavakkot Saw Mill which was dependent on the areas so exploited for its supply of timber. Experience has shown that the cost of log production from the evergreen forests is so high and the value of the common species so low that these operations could not be made to pay. Further, experience has conclusively shown that a modification of these methods of exploitation is absolutely necessary from silvicultural considerations. The correctness of this decision is confirmed by the opinion arrived at during the Silvicultural Conference at the Imperial Research Institute, that it will take at least ten years before a satisfactory method of working evergreen forests can be evolved.

The fact is stressed in the report that this work has all been of an experimental nature and that this fact is sometimes lost sight of as so much was claimed for these works at the outset. Although these operations have not proved successful, useful lessons have been learnt.

It is distressing to note that the saw mills made use of in connection with the exploitation of the deciduous forests have

shown disappointing results and that it has been decided to close down these mills, with the exception of two about which no decision has yet been reached.

Good progress has been made in the revision and in the preparation of fresh Working Plans. The special branch is at present concentrating on the more important areas, whilst local officers do what they can in respect of others. All plans, whatever their agency, are scrutinized by the Working Plans Conservator.

Increases are recorded in the amount of timber and fuel extracted by departmental agency and these figures are likely to increase still further as more Working Plans are prepared and put into operation. There was a decrease in the amount of sandalwood extracted by 149 tons, but the average price obtained showed a further increase.

Under Minor Forest Products it is interesting to find the opinion expressed that departmental collection will probably be necessary to obtain proper development. Lac has been successfully established in one Division and experiments are now being undertaken in other localities.

Natural and artificial regeneration appear to have been on the whole fair in spite of a year of uncertain rainfall. The problem of the working and regeneration of the evergreen forests is receiving careful attention and experience to date points to light selection fellings, followed by restocking of the gaps with valuable species, as being the most suitable method of dealing with these areas both from a financial as well as from a silvicultural point of view.

A total area of no less than 3,421 square miles has now been handed over to Forest Panchayats, leaving a balance of 15,493 square miles of reserved forests under the control of the Forest Department.

The report also contains an interesting summary of the progress made in Forest Administration during the five years 1924-25 to 1928-29.

FORESTRY, VOL. III, NO. 2.

Number 2 of Volume III contains many interesting articles
viz.:—

Environment and Disease, a Discussion on the Parasitism
of *Armillaria mellea* Vahl. Fr. By W. R. Day,

Silvicultural Research in India, its Organization, Problems,
and Methods. By H. G. Champion,

Forest Soil Science in Sweden. By G. V. Jacks,
Afforestation in South Africa. By H. M. Steven,

A Report on the Proceedings of the Seventh International
Congress of Forest Research Stations, held in Stock-
holm, July, 1929. By W. H. Guillebaud.

The Society was found in 1925. Since the publication of
the last number of the Journal the constitution has been amended.
The object remains as before, *viz.*, to advance and spread in
Great Britain the knowledge of technical forestry in all its
aspects. Professional membership has now been divided into
two orders; Fellows, being holders of a degree or diploma in
forestry and subjects of the British Crown but not necessarily
resident in Great Britain, and Associate Members, being
whole-time foresters not eligible for Fellowship, and Ordinary
Members.

**THE APPLICATION OF SILVICULTURE IN CONTROLLING
THE SPECIFIC GRAVITY OF WOOD.**

BY B. H. PAUL, Tech. Bull. 168, U.S.A., Dept. Agric., 1930.

This 19-page publication is based on a very considerable amount of careful field and laboratory work on typical broad-leaved and coniferous woods, but it must be admitted that the outcome hardly seems commensurate. In the author's own words—the phraseology might well have been inverted—"the results obtained are well supported by the experiments of the earlier workers". The reference is mainly to the well known and

generally quoted researches of Robert Hartig, 1884-1901, and the connected work of Cieslar, Janka and others.

The investigation was undertaken from 1922 onwards as a result of the general feeling, which we in India can share, that it is as well to see how far the timber from the new crops we are raising from natural and artificial regeneration will differ from that from the old and often virgin stands we have been harvesting hitherto; further, to see what can be done to maintain and if possible to improve the quality of the timber of the future. Our difficulties in producing suitable material for aeroplane spars during the war indicate the desirability of work in this direction.

The marked difference in behaviour of broad-leaved and coniferous species is further established. For the former, whether of the ring porous or diffuse porous type, crowding results in decrease in specific gravity, and with it the strength of the wood, and thinnings promptly bring about an improvement. From the point of view of the production of timber of high quality, a thinning procedure which maintains the width of the annual rings at a constant and fairly high figure, is the best.

The case of conifers is less regular and simple, and contradictory results are sometimes obtained. The specific gravity and strength of the wood depends not so much on the width of the annual rings as on the proportion of the denser summer wood. Young trees widely spaced and so with large crowns produce definitely lighter wood than those with narrow crowns in crowded crops. After thinning, the latter type sometimes shew an increase in specific gravity and sometimes the reverse according as to whether the wider rings do or do not contain a higher proportion of summer wood. In open crops, heavy wood appears to be produced when conditions of soil moisture and fertility are favourable and influences such as repeated burning which act adversely on the soil will result in lighter wood being produced. The treatment indicated is thus regular moderately heavy thinning and general protection.

It may be noted that the range in specific gravity and strength in different samples of the same wood is a large one, generally of the nature of 20%, and with *Sequoia sempervirens*, the author finds a greater difference caused by difference in growing space on the same area, than the average difference of close grown trees from the best and poorest sites on which the species grow.

The bulletin is well illustrated with 12 plates, partly microphotographs and partly photographs of the types of trees studied, and by 11 tables of specimen experimental data.

H. G. C.

EXTRACTS.

THE TRAINING OF FORESTERS.

In the correspondence on the subject of the "Training of Foresters" which was started by Mr. Pope in the January number of this Journal, many divergent points of view have found expression. Mr. Pope's letter is notable in many ways; its main theme is that thirty years ago foresters were trained in the school of experience and the only entry to the higher positions in forestry was by the path of labourer, woodman, working forester, a path which could lead to the highest ranks. Now there are schools of forestry at several of our universities, and men from these schools expect to enter forestry at a higher grade; and, though this does not entirely preclude the possibility of men who have been trained in the old way reaching the most responsible posts, *it so greatly reduces the likelihood of this advance* that it may be doubted whether it is worth while for an ambitious woodman to sacrifice the pleasures of youth on the altar of ambition; he has more chance in other professions. However, the situation might be improved if the Forester's Diploma of our Society were taken more seriously and were made the hall-mark of the accomplished forester.

Mr. Milne Home's long experience as a land agent gives great weight to his view that, "from the woodland owner's point of view, a man who has worked his way through all grades is more likely to make a competent head forester than the university graduate." "There is room for the university graduate in the Forestry Commission service or in advisory capacities, but he cannot replace the head forester of the type described by Mr. Pope." In the present number, Colonel Leather goes even further, and is ready to back the "shirt-sleeves forester" as against the "blackcoated forester" on any estate.

Private forestry in Britain has never recognised the distinction between the Forstmeister and the Forester, which is characteristic of German forest administration and has been adopted generally in state services—the

university trained Forest Officer who is responsible for policy, working plans and sales, and the Forester or Ranger, who is trained at a forest school for executive functions. Nevertheless, on the larger private estates the duties, though not the personnel, may be classified in this manner, since it is the same classification as is found in all industrial management. Since, however, the title, "Forest Officer" is redolent of a state service, we will replace this title, when dealing with private estates, by "Forest Manager".

It is usual to find in well-cultivated private woodlands that the duties of the forester are very efficiently executed. Nursery work in Britain is as good as can be found anywhere; our plantations can compare with any in the northern hemisphere, and there is very little waste in felling.

But practical work, however good, will be rendered ineffective unless it is supported by able business management. Profits depend as much on active thinking as able performance, and it is on the thinking side of the work that British estate forestry is generally weak.

Let us take an example. An area of 2,000 acres of woodland, managed as an efficient unit, with plantations of all ages, should contain timber to a standing value of some £10,00,000 to £1,50,000. The net income derived from these woods should be from £1,500 to £3,000 a year according to soil and position, and it should be the object of good business management to make this net income as high as possible in relation to the capital which produces it. And yet there are very few estates on which the net income even approaches the maximum that might be obtained and on most estates less than £1 an acre profit is realised from the woodlands. This failure to make estate woodlands pay is due to many causes; in many woodlands there is no management at all; in others there is too great a reluctance to fell trees when they have ceased to put on effective increment; in the management of others the intention is excellent but, owing to ignorance or lack of enthusiasm, money is wasted in every department of the organisation. On such estates the loss may sometimes be measured in thousands a year.

The man who is responsible for this is the forest manager; but it is often difficult to find out who the forest manager on an estate is. The happiest case is that in which the owner, imbued with a love for developing his estate, is himself an active forest manager. More frequently, responsibility devolves on the agent, and where the agent is a keen forester, this system works well. Unfortunately, however, the agent's time is so much taken up with other matters that it is only by exceptional good fortune that he can give adequate attention to the woodlands. Finally, it may be the forester, trained in the hard school of experience, who is able to give his whole attention to the woods; but usually he is paid a salary which is altogether incommensurate with the responsibilities which he undertakes.

On a well-placed estate, an able forest manager may often increase the net income from the woodlands by £1 per acre without cutting more timber than the dictates of conservative forest management allow. Thus, on many

estates a very attractive salary could economically be paid to a forest manager if a sufficiently competent man could be secured. Such men, however, are hard to find, and it is doubtful whether any institution, or any other training ground of whatever form, exists to-day in Britain, which is capable of turning out men of the type that is most required. A forest manager needs a thoroughly sound knowledge of British forestry, an active market sense, courage to break away from traditions, the energy and resolution to carry through long period schemes, and those human qualities which are essential for the management of men.

Men of very exceptional qualities will come to the top by whatever roads are open to them, roads which are often too rough for the ordinary man to tread. But very exceptional men are generally drawn to professions which are either more lucrative than forestry or offer a wider scope for their activities. The problem with which we are confronted is that of making the best forest managers from the quality of men at our disposal, and in exploring the avenues by which men may become forest managers, three kinds of training present themselves.

The first is the education at the forest schools at our universities. These schools have adapted themselves to the training of boys from schools, who have no previous experience of forestry. The training which they give is in the first place intended to qualify them for posts in the imperial forest services, since it is these that offer the greatest number of openings for graduates in forestry.

Those qualities which are of special value in British forestry are seldom found in the students when they come to the universities, nor are they ordinarily implanted in them during their undergraduate years. It is never fair to judge a school by its duller students, but the average graduate from a university school knows little about the enterprising use of exotics, the problems of handling difficult soils, marketing timber and thinnings or the every day routine of management. Such things he must learn later. The schools can justly claim that very few of their men are employed as estate foresters, and until the demand arises it would be wasteful to give men the special training which is required for British estates.

The second road by which men may reach the more responsible forestry posts is by starting as a labourer, progressing through one of the two Forestry Commission Schools and afterwards gaining experience in management as a forester in the lower grades of the Forestry Commission or on a small estate. Men who have followed this course may ultimately end up in very responsible positions on a large estate or may become forest officers in the Forestry Commission; but only small proportion of them reach such positions. There is likely to be more scope for such men in the Empire than at home.

This sort of training is admirable from many points of view, and on a large estate a forest manager must have trustworthy men under him who have been through such a course. But men who had been

schooled in the woods often lack the schooling of the classroom and this may remain as a handicap all through life. In Scotland many of these foresters have attended a secondary school before going into the woods, and this gives Scottish foresters a very great pull over their English colleagues, since up till now very few of the English practical foresters have had more than an elementary school education.

It is very desirable that men who have passed through such a course and have proved their ability in the lower grades of the forestry profession, should have an opportunity of attending a university course before advancing to the higher ranks. Such a course gives them a much surer scientific foundation for their work, as well as a broader outlook on the scope of their profession. A university course, however, is of little use to a man unless he has had sufficient previous education.

The third type of man who may become a forest manager is one who has had experience in general business management, and comes to apply that experience to forestry without pretending to know much about the technical side of the silviculture. Many landowners who have distinguished themselves by the excellent management of their own woodlands have been through no forestry course and simply use the experience that they have gained in other walks of life. Nevertheless, it is safe to say that most of them wish that they had been able to go through a technical training at some time or other. The best men will come to the top by whatever road is open to them but it is unsafe to deduce from this that the road that any particular man has taken is the best one.

Very few of those who are interested in the management of estate forests think that the present systems of training are satisfactory; but until the owners of private woodlands are willing to pay good salaries to the managers whom they put in charge of extensive areas, no great improvement can be looked for unless the Forestry Commission makes demands on the basis of its own requirements. The low salaries which foresters at present receive are partly due to their own fault. So long as a man will take charge of forests worth hundreds of thousands of pounds at a salary little above that of a labourer, very few able and serious workers will engage in the profession. There is room for much more co-operation between estate foresters with the primary object of increasing their salaries and improving the status of their profession, and it may be found, as it has already been found in other professions, that in order to improve their position it is necessary to secure a professional status based on the passing of examinations. As Mr. Pope has suggested, the forestry diploma of the Royal English Arboricultural Society might be used for this purpose, but it may prove desirable to inaugurate a more advanced examination which can be taken by experienced foresters. The standard of this examination might be such as to qualify men for the post of forest officer in the Forestry Commission or for appointments which carry similar responsibilities on private estates.

(Quarterly Journal of Forestry.)

DEVELOPMENT OF THE USE OF INDIGENOUS TIMBERS FOR SLEEPERS AND CARRIAGE BUILDING.

As was explained in last year's report some time must elapse before definite conclusions can be obtained as to the suitability of all the timber species now being tried out, but investigations continue, with the collaboration of the staff of the Forest Research Institute, Dehra Dun, into the increased use of various indigenous timbers for sleepers and coach building.

Extended use was made of the North-Western Railway sleeper treating plant at Dhilwan in the Punjab. During the year seven lakhs of sleepers were treated in this plant of which 312,000 were chir (*Pinus longifolia*) and the rest fir and blue pine. The average cost of treatment was about Re. 1-13-0 per broad gauge sleeper. There are still large numbers of chir sleepers, treated by the open tank method by the United Provinces Forest Department, on the North-Western and East Indian Railways, that are still in good condition after 14 years service. The treated chir sleeper is at present the most economic wooden sleeper on the market. An incising machine was obtained for use with fir sleepers, to obtain better penetration of the preservative fluid, but considerable difficulty was experienced with the frequent breakages of the knives.

A sleeper treating plant was erected during the year to treat Assam hardwoods at Naharkatiya on the Assam-Bengal Railway. This plant began to operate at the close of the year. The capacity of the plant is about 2½ lakhs of metre gauge sleepers annually. Plans and estimates are being prepared for the proposed plant at Jharsaguda on the Bengal Nagpur Railway. This plant will deal chiefly with sal sapwood and *asna* (*Terminalia tomentosa*) sleepers, both of which from experiments made by the Forest Research Institute show every promise of providing excellent sleepers. The project of erecting a plant in South India was abandoned as the railways concerned could not guarantee a demand for a sufficient number of sleepers annually to make the scheme an economic proposition. The Mysore Government plant at Bhadarvati began to operate during the year but, from reports received, some difficulty has been experienced in seasoning the sleepers.

The erection of a kiln-seasoning plant of the Sturtevant type with an annual capacity of 3,000 tons of converted timber for carriage building was begun during the year by the East Indian Railway at Lillooah. The results of the trials of small lots of some of the more common indigenous timbers made by various railways are being carefully watched. About half of the timber consumed in the carriage shops of the Class I Railways is used for repair and other miscellaneous purposes, whereas, at present, only about 23 per cent. of this timber is of miscellaneous species other than Burma teak. It is clear, therefore, that when the value of the miscellaneous timbers is more fully known and the seasoning plant now under erection begins to operate much more use

can be made of these timbers. Much more attention is also being paid to the proper seasoning of timber.

Another trial is being made in the construction of four coaches of kiln seasoned timber. One of these, of Central Provinces teak was finished during the year. Timber for the other three has been collected at Lillooah, East Indian Railway.

The total amount spent on timber other than sleepers by Class I Railways (excluding His Exalted Highness the Nizam's Guaranteed State Railway and Jodhpur Railway) during the year was Rs 83.45 lakhs

SLEEPER POOL COMMITTEE.

The total number of sleepers purchased during the year and distributed among the Railways comprising the Pool were 2,193,213 broad gauge and 1,420,026 metre gauge. There was a decrease of 653,310 broad gauge as compared with 1927-28. This is chiefly due to the fact that no sleepers were received from Nepal during the working season of 1927-28 and also partly by the decision of the Railway Board to take less wooden sleepers in view of their uneconomic value when compared with metal sleepers. No foreign wooden sleepers were imported by any railways in the Pool. The prices of coniferous sleepers in the Northern Group were somewhat easier. In the Eastern Group prices were maintained at the same level as last year; efforts are now being made to arrange three year contracts at reduced prices in this Group. All the wooden sleepers required were available.

The total amount spent on wooden sleepers on Class I Railways (excluding H. E. H. the Nizam's Guaranteed State Railway and Jodhpur Railway) was Rs 2.64 crores.

(Capital.)

THE CINEMA IN FORESTRY.

A short film of some of the Forestry Commission's operations at Thetford New Forest, Norfolk, was shown privately yesterday to members of the Forestry Commission and of the Council of the British Wood-Preserving Association. The film dealt with the growth of the Scottish pine and showed in detail the operations of cone collecting, the extraction, cleaning, and sowing of seed, the lifting, grading, and relaying of transplants, and the final planting in furrows. Typical views of the "Breck" district before being planted over were shown, also pictures of the two, four, six, and eight-year-old plantations, the film concluding with a view of a typical forest worker's holding. The film, which was taken for the British Wood-Preserving Association, will, it is hoped, form the first portion of a longer film which is under consideration, and which will cover not only the life of the tree from seed—sowing to felling and conversion—but also the various processes which cut timber should go through in order to render it proof against fire, dry-rot, fungal attacks, and the ravages of marine worm and of the death-watch beetle.—(*The Times*.)

A PARASITE ON A PEST OF WATTLE.

Two years ago the Madras Agricultural Department imported a unique kind of parasite from South Africa and Australia to put an end to the ravages of a pest which was playing havoc among the wattle plantations on the Nilgiris, the bark of which is generally used in tanning hides and skins. The parasite which is technically called *vedelia* was imported in small quantity and was multiplied at Ketti by the Agricultural Department and afterwards let loose in the plantations. The plantations are now free from the pest. *Vedelia* will be supplied to other plantations if necessary by the Department.

DESTROYING PRICKLY PEAR.

Success has also attended the introduction of cochineal insects which were imported from Ceylon to Tuticorin for the destruction of the prickly pear. These insects are now in great demand in different parts of the Presidency and the Agricultural Department is meeting the demand to some extent.

One peculiar characteristic of this insect is that it can only feed on the prickly pear and if there is no prickly pear, the insect dies out rapidly.

(*The Pioneer.*)

INDIAN FORESTER.

SEPTEMBER 1930.

THE INTRODUCTION OF TEAK IN THE UNITED PROVINCES.

BY E. A. SMYTHIES, I.F.S.

Teak of the scrubby stunted variety occurs naturally on the rocky barren hills of Bundelkhand in the south of the United Provinces, which adjoins the similar teak areas of the Central Provinces. But this note deals only with the introduction of artificial teak in the United Provinces.

The species was first introduced in plantations over 50 years ago. There was a 30 acre plantation made in Gorakhpur (Ramgarh) in 1877, and felled down in 1922. There are a number of teak plantations along the Upper Ganges Canal, more particularly in the northern sections near Roorkee and Meerut which appear to date from about the same time. There are a number of small teak plantations in the B. N. W. Railway station yards, there are old scattered trees in Dehra Dun, a plantation of 56 years old in Pathri, a Tarai area in Saharanpur division, and another on very dry Siwalik boulder soil at Ranipur in the same division. I have seen a group of teak about 25 years old in a mango *bagh* of Raja of Salimpur, and scattered trees are found in various plains, towns and stations.

But within the last 10 years the United Provinces Forest Department has taken up the introduction of teak on a really big scale, and experimentally over an astonishing range of conditions

of soil, rainfall, and growth generally. To mention a few of the experiments first:—

1. *Haldwani division*.—On rich fertile well-drained loam of the Bhabar terraces (in potential 1st quality sal soil and climate). Here the growth promises to be wonderful.

2. *Pilibhit division*.—On the sandy loam of the frost *chardars*, i.e., areas where sal shoots have tried to struggle through the frost for 50 years or more and have failed to do so.

3. *Afforestation division*.—On the driest semi-desert soils of the Etawah ravines with an underlying kankar pan, i.e., growth conditions that kill even the hardy *kikar* (*Acacia arabica*).

4. *Afforestation division*.—On bare usar (salt) plains where nothing grows.

5. *Tarai and Bhabar forests*.—On the edge of the damp and humid Tarai.

6. *Ramnagar division*.—On the hills of Siwalik sandstone.

7. *Gonda and various other places*.—On pure stiff clay and on pure loose sand, and every intermediate stage of soil and loam.

In fact we can claim to have tried teak under every possible and impossible condition of growth except in the coniferous forests of the high Himalayas! And although some of these experiments are bound to fail, e.g., Nos. (2) and (3), the remarkable thing is that this species usually proves at least as promising as anything else tried in each possible locality. Thus on the worst of the Etawah ravines the height and diameter growth practically stop at about 20' and 6" respectively, but the tree survives while other species disappear altogether. On the best growth conditions (e.g. Haldwani Bhabar terraces) the teak easily outdistances all its competitors and goes to 25' height and 5" or 6" diameter in 4 years.

On the large scale, teak is now used extensively in several divisions of the Eastern circle (e.g. Gorakhpur, Gonda, South Kheri) to fill up failures in sal coppice. In parts of Gorakhpur particularly the introduction of teak is on an extensive scale. These are usually 3rd quality sal areas and teak cuttings can compete successfully even against sal coppice shoots.



Teak coppice regeneration. Ramgarh Gorakhpur Division. Area clear felled March 1922.
Photographed February 1923. Shoots 10' to 18' high.



West Lehra sal taungya 4 years old.



West Lehra teak taungya 4 years old.



Ranigarh Teak plantation 45 years old, with abundant natural reproduction.

Why this sudden and violent predilection for teak ?, and to what extent are we justified in introducing it into our sal forests?, and what will be the ultimate result? These questions deserve careful consideration, and I will endeavour to answer them.

The first is easily answered. Teak in the United Provinces is extremely easy to grow, so easy in fact that we have taken unwarranted liberties with it. Cuttings can be transferred from one end of the province to the other with impunity and give 100% success. Cuttings have been planted out on dry hot unirrigated soils in the winter and some have survived and shot up in the rains. Cuttings have been planted out under fairly dense shade and have successfully come up unweeded and untended. Cuttings have even been put in upside down by accident and still not failed. Thus with reasonable care and on suitable soils primary success is practically assured. With best conditions, the results are amazing. Thus in the 1929 teak plantations in Haldwani (irrigated cuttings on good soil) by October the average and best plants were 6' and 14' high, and 0% failure. The 1928 plantation is already a closed canopy of teak, which requires no further attention. By comparison with our indigenous sal (the artificial regeneration of which has never yet succeeded except with *taungya* or in nurseries) teak is child's play. Easy as it is to introduce artificially there is every indication that it will be still easier to regenerate naturally. Everywhere in the province where there are a few teak trees over 20 years old, and the surround is protected from grazing, we find abundance of natural regeneration. The Ramgarh plantation in Gorakhpur is the best example.

Nothing has been done to the area except to remove a quarter of a million spare cuttings in the first two years (for planting up other areas), and frequent thinning out of surplus stems subsequently and there is every indication that the naturally regenerated crop will be very much better than the original planted crop. The latter was nothing very striking as teak plantations go, but it was sold standing for Rs. 1,000 per acre at 45 years' age which is a sufficiently satisfactory return.

This example to some extent answers the second question. We have every reason to think that teak will grow in a great

many places where sal wont. For the poorer quality forests of the Eastern circle with a keen demand for poles and some sawn timber, teak should prove at least as profitable as any miscellaneous species, even if it is only 3rd quality. The point which is exercising our minds at present is to what extent we should introduce teak into blanks in our good quality inaccessible sal forests, where the demand is only for large sawn timber and trees of 24" diameter. Personally I believe that a locality which produces 1st quality sal will also produce 1st quality teak, but only time will show whether this is correct or not. At least we know that the teak timber grown in the United Provinces has passed the Forest Research Institute timber testing with honours, and should, therefore, prove as valuable per cubic ft. as sal and more valuable than any other species. It certainly grows faster than sal, and will probably require a 20% shorter rotation, thereby again proving financially profitable. The following figures of plantation grown United Provinces teak are interesting :—

I. Ramgarh teak (natural regeneration), seven growing seasons from date of clear felling :—

Mean height of crop	...	...	= 30'
Mean b. h. diameter	...	...	= 4"
Maximum b. h. diameter	...	...	= 7"

II. West Lahra teak *taungya*, four growing seasons from date of sowing :—

Mean height of crop	...	...	= 22'
Mean b. h. diameter	...	...	= 2.7"
Maximum b. h. diameter	...	...	= 4"

Taking everything into consideration, we have good reasons for the policy of extensive introduction of teak in the United Provinces. The third question is, I think, also easy to answer. In the majority of cases where we have introduced teak into gaps in sal forest, it seems fairly evident that the teak will be a good and valuable substitute. It regenerates naturally like a weed. Teak in the United Provinces produces flowers at 5 years old, gives fertile seed at 10 years, and natural regeneration at 20 years. It has no establishment period, but shoots away like an arrow with sufficient light,

and it is practically unaffected by deer browsing, fire, or drought. The only damage so far recorded is by rubbing of horns of deer, and in one case by a borer. The Gorakhpur teak and sal *taungyas* side by side afford an interesting comparison, the one is 20 feet high when the other is 4 feet. Another example near Madhulia in Gorakhpur may be cited. An experimental sal plot was laid out in 1913. In 1922 it was noted that a few natural teak seedlings had somehow appeared. In 1930 the experimental plot was abandoned. After 17 years the sal regeneration was exactly as it was in the beginning, while the natural teak that had appeared in 1922 was up to 30 feet high. It is difficult to see how sal or *anything else* is going to compete against teak in suitable localities.

The problem of the pure teak plantation which exercises the minds of foresters in Burma and Madras, will not, I think, prove a problem here, where there are many shade bearing trees and shrubs, e.g. *Mallotus philipensis* and *Eugenia Jambolana*, which could form an understorey and protect the soil. Also we can (and usually do) introduce a 20% or 30% mixture of the bamboo *Dendrocalamus strictus* which is of considerable value. Unfortunately we have in the past frequently mixed other species, such as *Dalbergia Sissoo*, *Albizzia procera*, etc., and such mixtures are undoubtedly silviculturally unsound.

Apart from its introduction in schemes of afforestation, one object of this note is to give the reasons which appear to justify the policy of planting teak in gaps in sal forests. These may be briefly recapitulated as follows:—

- (1) It is far easier to regenerate most areas with teak artificially than with sal (artificially).
- (2) There is every indication that when once introduced teak will continue to regenerate naturally with ease.
- (3) Per cubic foot teak should be at least as valuable as any other species we could introduce, and teak will certainly be more valuable than grass or weeds that occupy such blanks at present.
- (4) The rate of growth of teak is faster, and the rotation would be shorter than sal.

- (5) Teak has hitherto been introduced most extensively in poor quality areas with a keen demand for small poles, and even poor quality teak will produce these in abundance.

The policy of introducing teak into gaps in our good quality but inaccessible sal forests is still under consideration. The arguments against it are :—

- (1) We are not certain that 1st quality sal areas will be 1st quality teak areas, or that we shall ultimately obtain big beams, Broad Gauge sleepers, etc., therefrom.
- (2) The element of risk. There must be some reason why teak does not occur naturally in these forests and although all the available evidence points the other way, the teak might fizzle out and disappear before maturity.

The present policy of introduction of teak in the United Provinces may be summed up in a few words. We are introducing it freely in schemes of afforestation and plantations to replace comparatively valueless forest by more valuable species wherever growth conditions appear promising. We are also introducing it freely in gaps in sal forest of poor quality where there is a good demand for poles. We are hesitating about its introduction into the best sal forests and more inaccessible areas. We do not introduce it at all where we can get adequate sal regeneration. In other words, teak plays second fiddle to sal, but first fiddle to all other species.

RIVER TRAINING WITHOUT EMBANKMENTS IN BURMA.

BY G. C. CHEYNE, RIVER TRAINING EXPERT.

[The following is an address given to the Rotary Club, Rangoon, by Mr. Cheyne, M.B.E., River Training Expert, Public Works Department, Burma. Mr. Cheyne was formerly in the Indian Forest Service and developed the practice of River Training while in charge of the departmental extraction of teak. As a result

of the work carried out by him, he has been transferred to the Public Works Department as River Training Expert.—HON. EDITOR.]

In his presidential address to the Association of Engineers in Burma last year, Mr. J. D. Stuart remarked :—

“The method of training rivers without embankments introduced with great success by the Forest Department under the direction of Mr. Leete, late Chief Conservator of Forests, has been adopted in connection with streams in the Pegu District. Before training was undertaken, these streams pursued erratic courses over the country, building up small deltas for themselves and breaking away at random in the direction of least resistance, with the result that no part of the area was safe for cultivation. The effect of the training works which have been undertaken has been that the floods have been controlled to a very great extent and that large areas of land have been methodically reclaimed by the silt brought down from the hills, and are safe for cultivation. The method adopted is to cause silt to be deposited on both sides of the channel by obstructing the flow of water with bamboo stakes. Wide, flat banks are thus built up by the stream. When all the reclamation possible is done on one line, the stream is diverted to a new course parallel to the old one, and the process repeated, the result being the gradual and methodical reclamation of the deltaic area on to which the silt used to be deposited at random. Apart from the great improvement caused by stabilising agriculture in this area, the railway to Mandalay and the trunk road have been given a measure of security which they have never previously enjoyed.”

The present address is a brief explanation of the actual methods employed showing their possibilities for reclaiming and improving the drainage of enormous areas of swampy land. In order to give you some idea of the origin of the present method of river training works I will give you a brief history of the work done by the Forest Department in the Myitmaka valley. The Prome and Tharrawaddy forests lie on the western slopes of the Pegu Yomas, and are drained by the feeders of the

Rangoon River which, at its headwaters, is known as the Myitmaka River and lower down as the Hlaing River. This river has a total length of 230 miles.

All the Yoma torrents, due to their reception basins being highly susceptible to the excavating power of the rainfall, carry enormous quantities of silt and rubbish of all sorts during floods and, when their flow is checked by the backing-up action of the Irrawaddy in flood, silt is rapidly dropped ; the section of the stream gets smaller, logs and rubbish brought down by subsequent rises cause the complete obstruction of the channel and the result is a change in the course of the stream.

NO ADEQUATE CONTROL IN THE PAST.

In the past no adequate control was maintained, with the result that there were continuous changes in the channels in their lower reaches and the torrents traversed the plains in all directions, but these divagations served at any rate to raise the level of the plains. The teak forests in the Zigon and Tharrawaddy divisions were always managed departmentally in order to provide a stock of timber for auction sales at the Government Timber Depôt, Rangoon. Various reasons were given to account for the deterioration of the streams. The floating of timbers from these forests to Rangoon gave rise to various controversies between the Civil and Forest Departments during the past thirty years. Both Civil and Railway Officers assailed the Forest Department as the cause of the evil and there can be no doubt that the lack of adequate floating control and the failure to remove obstructions as soon as possible after formation were the principal causes. In 1909 it was seriously proposed to abandon the rivers altogether in favour of extraction by rail. It was argued that the cost of this method as compared with the apparent cost of entire water transport would be more than compensated by the fact that there would be a smaller loss of logs in transit and a quicker return would be made certain. The loss of logs when passing through the deltaic mouths of the streams where they join the Myitmaka had been considerable. The boom experiment was first tried on the Shwele stream

near Paungde. Logs were collected by means of a boom across the stream, hauled out by winches, loaded by jib cranes or gantries into trucks and railed to Rangoon. The Shwele depôt was in full work during the seasons of 1913 and 1914 and was a successful experiment until a better method was found in 1914 and the depôt was finally closed in 1915. The losses in transport when the boom was in vogue were often as high as 5 per cent. and undoubtedly a large number of logs which escaped from the boom was irretrievably lost in the silt deposits of the lower reaches of the Shwele stream.

In 1914 after consultation with the late Mr. Samuelson, Mr. Leete decided that the most effective way to improve matters would be to double embank the channels at the places where the well defined channels began to deteriorate. High embankments were therefore made at critical places on four of the streams before the 1915 rains. These measures were most successful so far as the embankments extended, but no good channel was obtained below the end of the embankment and logs were spread out fanwise over a large area. The problem of how to carry on further improvement in the channels subsequent to the rains of 1915 now arose. Engineers strongly recommended that the high embankments should be extended but in 1916 on the grounds of economy the experiment was made of substituting low embankments for high embankments. Low embankments were made in the Taungnyo stream for a distance of a mile in 1916; however the moment an embankment is overtopped by a flood, scouring immediately takes place from the outer side of the embankment towards the stream, therefore the embankments were breached in many places during the first jungle flood, and the experiment proved a failure. Experience however gained in dealing with the enormous breaches which destroyed the low embankments proved the value of bamboo stake fences for controlling the flow of silt laden water. Mr. Leete, in his recommendations for the preparations for the 1917 rains, suggested the systematic application of the method which has been known to the cultivators in these riverine plains for many years.

GORDON'S REPORT.

That the germ of this idea had existed for a very long time can be shown by reference to Gordon's "Report on the Irrawaddy." In an extract therein given from a letter written in 1877 by Mr. Weidemann, Deputy Commissioner, Tharrawaddy, is the remark:—

"The plan now advocated is to run parallel with the stream a cheap and close fence along the inner side of which, during the overflows, a natural embankment of silt will be formed by operation of the current. That silt will thus form is proved by experience. When silt has once formed in sufficient thickness the fence will have done its work."

MODE OF PROCEDURE.

Although Gordon handed on the foregoing suggestion, he certainly did not realise its significance, because he himself continued to advocate the training of the streams by means of embankments. The idea remained dormant for another 37 years; it was not until 1916 that it showed signs of growth and that its value was demonstrated by practical application. High embankments were proved to be not a necessity but in addition to involving considerable capital outlay many disadvantages followed in their train. How then can bank formation best be promoted? The answer is, by bamboo stake fencing. The actual method of training now in practice will be best described by detailing the operations necessary during the year on an average stream in the Myitmaka drainage. At the end of the rains a channel has been formed to a certain point and kept in place by herring-boned strings of logs. Below this point the channel for some distance is clearly defined in the silt deposits, the late rises, after the Irrawaddy has subsided, having scoured a passage through the fan of silt thrown out in front of what may be considered the stream mouth. Side channels from this passage have been blocked with logs. Below this the channel is merely a depression in the stiff laha clay. The line along which it is desired to form the new channel is then pegged out and usually follows a natural depression but may have to be extended by a small cut. All jungle growth

to a width of 150 feet on each side of the line is cut down flush with the ground and burned or cleared away. At a distance of 100 feet on each side of the line simple bamboo fences are made. These consist of bamboo 5 to 6 feet long and pointed, driven into the ground about 9 inches apart with their tops dressed to an even height of about 3 feet above ground level. These stakes are lashed to a horizontal rail with coir rope about inches from their tops, to hold them in position. Where this fence crosses side channels the bamboos naturally stand higher out of the ground and must be strutted to enable them to withstand the additional pressure at these points. Any bad bends are eliminated by cuts. The low fences are continued just beyond the point which it is anticipated will be the limit of the silt deposit of the ensuing rains. The fences catch up the many kinds of small rubbish brought down on every jungle rise and form a barrier checking the flow of water and causing a deposit of the coarse silt, the finer particles being carried beyond it. In this way each rise serves to heighten the banks now forming, as well as to raise the level of the surrounding country. It will thus be seen that the channels being formed are not made by scouring a bed, but, on the contrary the stream is induced to deposit its silt evenly along its course and it raises banks for itself. Each successive rise further heightens the banks and lessens the overflow, thereby leaving more water available to flow farther downstream to enlarge the section there. Care must be taken to keep the fence in constant repair. With the continuance of this work the channels are being carried year by year farther downstream. Along the shelf of deposit on either bank of the stream cultivation of paddy has now been rendered possible where ten years and less ago, annually inundated scrub jungle was the only vegetation. Furthermore, this new cultivation is permanent and free from danger from all but the highest of the Irrawaddy floods, while the margin of absolute safety is annually being moved farther downstream.

It was incontrovertibly proved that given a timber that will float no form of transport can hope to compete for cheapness with water transport. In addition to reducing very considerably

the cost of transporting teak logs, river training works in the Myitmaka valley have already reclaimed over some 30,000 acres of previously inundated land and turned it into first class paddy land.

THE PRIMARY OBJECT.

The primary object of the Forest Department River Training Works is to obtain a channel through which to float teak logs as cheaply as possible and the channel once formed is very easy to maintain. The Civil authorities now propose to demarcate the entire area which has been affected by the training works since 1914, and over which no land holders rights have accrued. This will constitute a Government estate. This estate will include all the land which may be required in the future for further stream training, and, if the necessity arises, to move the course of any stream, either for cheaper floating of teak logs or for additional land reclamation, costly acquisition will not have to be faced if full control is obtained. If this estate is constituted as now proposed it is contended that many more thousand acres of valuable paddy land will be reclaimed in a few years and the process of frequent changes in the course of each channel or of opening large silt-carrying irrigation cuts to fill up depressions will in course of time render the whole of the Myitmaka valley culturable. I have tried, so far, to indicate the main outlines of the picture as unfolded in 1914 and subsequent years. The Forest Officers looked at the rivers primarily as a means of transporting their logs, but, that good results would ensue to cultivation by bringing the rivers under control and reclaiming inundated areas was realised from the start. Prominence was given to this probable outcome of the operations in order to enlist the sympathy of local civil officers. Experience has justified this optimism. Results could not have been better if the protection of villages and of cultivation from the destructive effect of uncontrolled flooding had been the primary objective. It may well, therefore, be claimed for the operations that they do afford a highly satisfactory solution of the problem from an engineering point of view.

Great as is the value of these rivers to Government for the floating of teak timber and other forest produce much greater importance should attach to using the silt brought down by these streams for reclaiming the vast areas of at present useless swamp lands which still exist particularly in the Tharrawaddy, Insein, Pegu and Toungoo Districts. It is not a matter of reducing the amount of silt brought down by the rivers; nothing appreciable in this respect is practicable because training works in the hills such as are carried out in France and Switzerland are absolutely out of the question. As the silt is bound to be dropped somewhere the amount of land reclaimed will in the long run be practically the same whether any control is exercised over the rivers or not.

It is a matter of ensuring that the silt is deposited where it is most needed so as to reclaim land systematically while at the same time guaranteeing protection to existing cultivation, villages and communications. If floating obstructions are not removed and if the indiscriminate tapping of streams for irrigation and the blocking of channels with fishery weirs are not properly looked after, the streams are certain to change their course at frequent intervals and cause promiscuous flooding with resultant loss to crops and damage to communications.

The systematic reclamation of land in this way is the main benefit of these works on heavily silt laden streams and there are enormous possibilities for such reclamation works over all the swampy land on both sides of the Pegu Yomas. On the west we have the area in the Tharrawaddy District between the Yomas and the Irrawaddy on both banks of the Myitmaka River, and on the east in the Toungoo and the Pegu Districts from the Kabaung Chaung just south of Toungoo right down to the Pagaing Embankment north of Pegu.

Work has progressed already on the area in the Pegu District from the Pagaing Embankment up to the Sittang Embankment on the north, at Kyauktaga. North of the Sittang embankment the Aingdon, Tonkan, Kun and Pyu streams with several smaller streams in between can be used similarly to reclaim further large areas of swamp.

THE SITTANG RIVER.

On the east of the Sittang River between it and the eastern hills there are very large areas of swamp. The reclamation of these swamps is a more difficult problem as the water from the eastern hills carries practically no silt. There are two possibilities for these areas; one, to use the silt from the Sittang river itself and another to divert the Sittang along the foot hills and develop the silt laden stream—the Kun, Pyu and others—across the present line of the Sittang through the swamps into the new line of the Sittang. The latter alternative may appear at first to be rather too ambitious but from the preliminary investigations made it is quite evident that the Sittang did flow along the line of the foot hills at one time and there will be little difficulty in diverting it back again along that line.

A few years ago it was decided to extend the Kyauktaga-Sittang embankment southwards for another 40 miles but this scheme was abandoned in 1925 in favour of training on the lines I have already tried to outline. Now, as a result of operations in the Pegu District, within a year or two reclamation and drainage in the area at present protected by the embankment will have advanced so far as to render the maintaining of this embankment no longer necessary. Indiscriminate bunding by cultivators along the Sittang is still being carried on and unless this is controlled it is likely to render conditions in the Toungoo and Pegu Districts similar to those obtaining in the Irrawaddy Deltas.

The Irrawaddy Delta is a much bigger and more difficult problem but the longer the tackling of it is postponed the more difficult will it become. Flood levels are likely to get higher and to meet this rise the embankments will have to be raised this will entail enormous expenditure with little guarantee of absolute safety. A breach such as happened at Ngathainggyaung a few years ago will be likely to occur and the higher the embankments are raised the bigger will be the calamity.

The only sound method of improving the conditions in deltaic regions appears to be, to open up through drainage channels and introduce silt laden water, and thus enable the river;

to carry on the work of building up its own Delta, which, in the ordinary course of nature, it would have done without embankments.

The benefits to the land which are or can be brought under the control of river training works are twofold: Firstly, large areas of swamp which are useless for cultivation are reclaimed by silt deposition. Secondly, the yield capacity of enormous areas is greatly increased. The following figures give some idea of areas to which river training works can be extended:—

- (a) The Myitmaka valley from the top of the flooded or laha area on the border of the Prome District right down to and including the Bawle Island: 1 million acres.
- (b) The Sittang valley from Toungoo down to Shwepyin: $\frac{1}{2}$ million acres.
- (c) The Pegu District: 2 million acres.
- (d) The areas now protected by the Irrawaddy Delta Embankments: 1 million acres.

Up to date river training works, with the exception of the work carried out by the Forest Department in the Myitmaka valley, have been more or less limited to an area of 350,000 acres in the northern part of the Pegu District.

The southern part of the Pegu District has been contoured. Contour surveys of the Myitmaka valley are almost completed. Investigations of the Sittang valley are in hand and it is hoped to have this area contoured next season. Of the embankments on the Irrawaddy I can say nothing further as it is at present outside the sphere of our operations and I understand Government are considering proposals made by Messrs. Nunes and Clarke as a result of their recent visit to the Mississippi.

PROVISION OF FINANCE.

The most urgent problem is the provision of funds to finance the projects. In the Irrigation Department projects must be productive, *i.e.*, they are designed to pay at least

6 per cent. interest on the capital expended plus the cost of maintenance of works done. In the case of Irrigation Canals it is comparatively easy to prepare a project on these lines as the cost of work to irrigate a known area can be estimated and extra rates over this area are estimated to pay the necessary 6 per cent.

It is obvious that these reclamation and drainage projects cannot be worked out on a similar basis unless Government has full control of the land as some land previously useless is reclaimed by silt while other areas are improved so as to give a very much increased yield and under present conditions enhanced rates of land revenue cannot be estimated until resettlement of the land takes place. It must also be remembered that these works are in their infancy in Burma; we are learning as we go along and methods to make such works productive are only in the process of evolution. These projects of the Irrigation Department, be they Irrigation Canals, Drainage or reclamation works, have been limited in Burma to increase in revenue in the form of water or drainage rates; no direct credit is given for the very big increase in the market value of land which results. Naturally land which is rendered cultivable for the first time or whose yield outturn increases, appreciates considerably in value and it seems to me only reasonable that the projects which lead up to this appreciation in value should get a direct credit for part of the increase.

In the Myitmaka valley as land was reclaimed by silt deposits along the banks of the log bearing streams, squatters took possession of it and when they had squatted on this land for 12 years and paid continuous land revenue they became owners of the land under the Land Revenue Rules. As the works in the Myitmaka streams were carried out by the Forest Department with the primary object of floating logs only, the works served their purpose and Government did not lose any money by this system. Now we are reclaiming land at a comparatively high cost purely in the interests of cultivation and it seems a reasonable proposition that Government should sell this land and thereby pay for the cost of the works.

The objection to big landlords can be got over by dividing such land into small plots and thereby giving the small holder the chance to secure really good land for himself and his heirs but personally I see no reason why big landlords should not be encouraged in Burma.

Big capital is required to develop big projects so why not let land development companies or the wealthy landlords who are interested in cultivation, help to develop the country and increase the outturn and quality of rice, the cultivation of which is Burma's staple industry?

The result of the present system in force in Burma is that the Chettiars own a large percentage of the land. Undoubtedly Chettiars have been a great help to cultivators and have done useful work in the country but the principle of mortgaging land and paying very heavy interest charges yearly to the Chettiars might be obviated by Government selling the reclaimed land on easy terms either to small holders or to companies or large holders who possess the necessary capital for development.

INCREASE IN LAND REVENUE.

The increases in land revenue in areas benefitted by our projects will of course be credited to them, but such comparatively small credits will only suffice to pay for the maintenance of the works.

To show the increase of land value consequent on river training the following two cases may be cited :—

1. Last year two new drainage channels were made in the Pegu District at a cost of roughly 2 lakhs. The beneficial effect of these cuts was felt over a very large area: in addition an area of 16,000 acres, which previously had only very precarious patches of cultivation yielding a very small outturn, immediately became entirely fit for cultivation and gave a very much increased outturn, so much so that the landlords levied a rental of as much as 15 baskets per acre over the whole area. Surely some proportion of this increase ought to be recoverable from the landlord and credited to the project.

Incidentally in the same area there is a block of 1,400 acres of Government waste land which is now cultivable. Were this

land put up to public auction either for sale or on lease and were other similar areas treated in a like manner adequate funds would readily become available not only to finance the work done but for further reclamation works.

2. Within the scope of the projects in the northern part of Pegu District some 70,000 acres are Government reserve and waste land. Within a very few years most of this land can be rendered fit for cultivation if funds are available for systematic reclamation.

Were such land put up to auction for sale or lease there would be no lack of funds to pay off the capital sunk in the original works. Within a comparatively short number of years there will be a huge increase in the cultivable area, a very much enhanced yield from existing cultivation and, with the co-operation of the Agricultural Department, a much better quality of paddy will ensure so that the increase in land revenue will be a very large one.

In conclusion I would like to add that the secret of the success which has attended the more recent efforts of training these streams lies entirely in the fact that there has been active co-operation throughout between the various departments concerned. The regulation of these rivers has now passed beyond the stage of experiment and has become such a simple matter that it attracts very little attention outside.

The possibilities of extensive reclamation and drainage are still enormous but progress is hampered by the lack of adequate funds. In my opinion the only way to remedy this is to demarcate all waste land and land likely to be affected by the river training works and to post a special officer to assess the enhanced land revenue on old land and the rental or sale value of new land made. If this is done I am confident that there will be a large surplus revenue after paying for the total capital cost of new works.

The recommendations of U Ba Pe's Flood Enquiry Committee should be put into effect, namely all private bunds already constructed should be taken over by the Irrigation

Department and in future no bunds should be constructed by private agency without the approval of the Irrigation Department. Legislation to deal with this problem will be necessary and the sooner this is introduced the better.

A NOTE ON ABANDONED AREAS IN KHANEWAL PLANTATION.

BY MANOHAR LAL MATTU AND RAM NATH KASHYAP, P.F.S.

I. HISTORY.

About 19,000 acres of the *rakhs* of the Multan district lying between the two arms of the angle formed by Khanewal-Lyallpur and Khanewal-Lahore railway lines were allotted by the Punjab Government for plantation in 1915, to be irrigated by a forest distributary from the Lower Bari Doab Canal. This area which is divided into 16 irrigation blocks, called *chaks*, was merely a part of the vast arid zone tracts of the Multan Division containing a scattered crop of *Prosopis spicigera*, *Tamarix articulata*, *Salvadora oleoides*, *Capparis aphvalla*, etc. The sub-soil water was 70' below the ground surface, the average annual rain-fall being about 4". This dry area was to be converted into a compact crop of shisham (*Dalbergia Sissoo*). With the two-fold object of making some revenue from cultivation of agricultural crops by leasing out the areas not immediately required for plantation purposes, and of getting the ground cleared of scrub jungle free of payment through the lessees, leases of temporary cultivation were given out for different periods varying from 2 to 4 years. These leases merged into one expiring in 1935-36. It is estimated that the revenue from this source will cover the entire cost of creation of the plantation. Unfortunately this cultivation being in all cases situated at the heads of water-courses, was in a more advantageous position as regards drawing water from the canal. The actual plantation was started in 1917 at the tail ends of the water courses where sowing along the berm of trenches 10' apart was adopted as the chief method of stocking. Annually a coupe varying between 500 and 900 acres was thus sown with the exception

of the years 1922 and 1923 when 2,500 and 2,700 acres were stocked. But the results were not uniformly successful. The ecological and edaphic factors affecting the growth, *viz.*, water supply, soil, sub-soil, winds, etc., will be dealt with in detail later on, but the sum total of their collective effect was noticed as early as 1918 in the heterogeneous character of the resulting crop which was an intricate mixture of small patches of good moderate and backward growths. By 1923 the backward areas had become a problem by themselves. A meeting of Forest Officers was called in July 1923 to tackle the question and it was decided that for obtaining satisfactory growth of plantation, a delta of more than 4' water was required, for which the forest officers continued to fight, and in 1926 a delta of 4' against 3' given so far over the gross area was sanctioned by the Punjab Government. In June 1927 stock map of the plantation was prepared, and the 9,370 acres planted till then, were divided into the following three quality classes :—

1st quality	2,689 acres	...	...	Normal.
2nd	" 3,958 "	...	...	(below normal.)
3rd	" 2,723 "	..	...	Dead and dying

The conclusion drawn from this was that owing to the shortage of water shisham could not be maintained in normal condition, and it was decided to reduce this area by abandoning the III quality crops. The idea was to save water from about 2,500 acres of such crops and utilize it over the retained area by giving them an extra delta of 1'. After further deliberation on the question it was decided in March 1928, to again open water to 672 acres (out of 2,500 abandoned) as they were in a fairly good condition. Further discussion on this question took place to make the propositions of utilizing extra water and closing water to the areas abandoned feasible, and thus the 'abandoned area' was finally fixed at 1,839 acres in October 1928. This area is distributed all over the plantation but *chaks* I, II, VII and VIII contain the bulk of it. These areas were abandoned with the intention of restocking them with *farash* (*Tamarix articulata*) which needed less water, after killing out the shisham.

2. FACTORS AFFECTING THE GROWTH.

Water supply, soil and sub-soil are by far the most important factors which affect the growing stock in the irrigated plantations and they will be examined in detail below:—

Canal water supply.—Canal water is the life of irrigated plantations. Although the very first demand for water by the forest officers was a minimum delta of 5', yet the actual supply by the canal department from time to time was as below:—

1917 to 1920 ...	... a delta of 3 feet.
1921 to 1925 ...	... a delta of 3.5 feet.
1926 onwards ...	... a delta of 4 feet (over the gross area, which works out to 4'5' over the planted area).

However in this connection two important facts have to be noted: (i) that the temporary cultivation was above the planted area and thus was in an advantageous position as regards the supply of water, and (ii) that till 1923 the outlets were open cuts in the distributary which could easily be tampered with. It cannot even be affirmed positively that the planted area was getting its authorized supply of 3' or 3.5' delta. On the other hand it is almost certain that the temporary cultivation received more than its due share of water. The area actually cultivated during these years was much more than that for which the water was available according to the agreement. As the need for better control and regulation of water was felt, it was decided upon in the meetings of forest officers in 1922 and 1923 that all open cuts in the distributary should be replaced by *pucca* flume outlets; and that more water should be asked for. Hence the cry for more water started in 1918 was continued and the enhanced supplies were thus obtained.

It is interesting to compare the water supply of Khanewal Plantation with that of the oldest plantation, Changa Manga. In the latter 802 cusecs are supplied for 8,900 acres of culturable area or one cusecs for 11 acres; while in Khanewal Plantation 246 cusecs are supplied for 16,500 acres or one cusecs for 67 acres of culturable area.

Rain.—This area lies in the arid zone and does not get more than 4" of annual rainfall on an average, which has little or no effect on the crop. In the hot weather of 1929 an unusually heavy rain of about 13" fell which did enormous good.

Soil.—On the whole the soil is very suitable for shisham being alluvial sandy loam, but it varies in quality and composition from place to place. Several pits were dug in the various *chaks* of the plantation in 1922-23 and observations were recorded. Generally there is a top layer, about 4' deep, of porous sandy loam, underneath which is found a hard impervious layer of clay, sometimes mixed with *kankar* below which there is pure sand. The depth at which this layer is found and its thickness vary from place to place. The impervious layer of clay is not found in certain parts, notably in *chaks* I, VII and VIII where most of the abandoned areas are located. This impervious layer of clay plays a very important part in the supply and retention of moisture for the growing plants. When it is absent, all the water passes down into the sand without benefitting the crop at all. It was in such parts that shisham refused to grow beyond the sapling stage.

There are other minor factors like hot dry winds, frost browsing of stray cattle and damage from wild animal, etc., but they are common for the whole of the area and have not done any appreciable injury.

3. CAUSES OF FAILURE OF ABANDONED AREAS.

From the above paragraphs we can trace out the causes of the failure of abandoned areas. In the order of importance they can be summed up as follows:—

(i) The absence of the impervious layer of clay and *kankar*, which does not allow the actual water given to be utilized properly, as all the water passes down into the sand below.

(ii) *Shortage of water supply.*—The plantation has been getting a delta of 3' from 1917 to 1920 when the whole of *chaks* I, VII and major parts of *chaks* II and VIII were sown. Considering that the temporary cultivation was getting a part of the

meagre authorized supply till 1923, this is hardly a matter for surprise that most of the crop in *chaks* I, II, VII and VIII failed.

(iii) The crop has thus been weakened on the whole and soon succumbed to the attack of the Shisham defoliator (*Plecoptera reflexa*), which further retarded the growth. The attack was heaviest in the weakest parts and they soon lagged behind.

4. CONDITION OF THE CROP AT THE TIME OF ALLOCATION OF 'ABANDONED AREAS' AND CRITICISM OF THE MEASURES ADOPTED.

These causes resulted in a heterogeneous crop stunted moribund patches alternating with healthy ones according to the nature of the sub-soil. Such patches vary in size, rarely covering one compartment completely. Cutting back was done over 1,588 acres, which did not give any satisfactory result. The cut-back stems coppiced vigorously at the start but the crop thus obtained again refused to grow beyond the sapling stage, although they put on and retained better foliage due to more water received. This proved beyond dispute that shisham is not the species for such areas; but it is questionable whether cutting off the water supply to 2,500 acres of 'abandoned' areas scattered over all the *chaks* in small patches was necessary. The cost of creation of this plantation is Rs. 65 per acre roughly, therefore this scheme which virtually meant the writing off of 2,500 planted acres, has three serious objections to it, namely :—

(1) That these areas which had suffered for lack of water for ten years, were given no chance to recoupe by giving them extra water beyond one year.

(2) That these areas were of such a scattered nature that the irrigation of the retained areas side by side with the complete stoppage of water supply to the 'abandoned' areas was the most impracticable, if not impossible, proposition, considering the facts that the work of necessity lies in the hands of unintelligent coolies. Without doubt the 'abandoned areas' were not in complete blocks but it was done a year later.

(3) The allocation of the abandoned areas in 1927 was not very natural, that is to say, all the three quality areas abandoned were not situated in sandy places without the impervious layer of clay

in sub-soil, as they should have been but in several cases their backwardness was due to lack of water. This is borne out by the fact that a fair amount of shisham is still alive in areas abandoned in 1927, inspite of water having been cut off for three seasons. This proves that soil in such areas is heavy enough to retain moisture.

Shisham having been killed in greater part of these abandoned areas, it was not possible to make any marked improvement on it, but attempts were made to bring them together in big blocks as far as possible. If the planted area had to be reduced with the object of making more water available for the retained area, then probably the best plan would have been to locate them in ring-fence blocks. This arrangement would have made future irrigation of both shisham and *farash* areas, taking different number of waterings, a practical proposition.

5.—RESTOCKING.

A three years programme was laid down for restocking the 1,839 acres abandoned finally, and the following operations were proposed to be carried out over about 600 acres each year :—

- (a) Complete removal of dead and dying trees from the area.
- (b) Burning of debris in heaps.
- (c) Reopening of irrigation trenches.
- (d) Restocking the area with *farash*.

This programme has been carried out for the year 1928-29. Operations (a), (b) and (c) were completed by the end of February 1929. All living trees whether single or in small groups were allowed to remain, while the dead trees only were cut. All saleable wood was stacked on the compartment roads and sold, while debris was burned in heaps away from the living trees. Operation (d) is described in detail below :—

Three parties started the work of restocking early in May as soon as the canal water was available. Each party took a coupe of 8 acres every day. The area was first thoroughly irrigated, that is to say, trenches were kept filled with water for about 24

hours, so that the berms of the trenches became soft enough to enable a *farash* cutting to be stuck in. Next *farash* shoot cuttings, about 15" long and as thick as a finger, were planted 5' apart (12" in the ground and 3" above). The areas stocked in May and June showed a success of about 10 to 15 % only, while that stocked in August and early September shows a success of about 50 to 70 %. Six to seven waterings were given to areas stocked in May, while only three or four were given to those stocked later. For want of funds no weeding was done, although it still remains to be proved that weeding is essential.

These *farash* areas were given a delta of 3.5' for May plantings and 2.25 feet for August planting. Shisham areas retained received a delta of about 5' approximately.

6.—CONCLUSIONS.

In view of the observations recorded in this note the following conclusions may be drawn :—

1. Wherever the sub-soil is heavy and can retain moisture, shisham does very well with a delta of 3.5' of water, as is borne out by the fact that first and second quality class crops existed before the supply was raised to a delta of 4', and groups of trees survived in abandoned areas inspite of their getting no water for three seasons.

2. *Farash* shoot cuttings should not be put in before the end of the hot weather and the beginning of rainy season.

3. On the basis of these conclusions the future programme of restocking the abandoned areas (in fact also new areas) with 3.4' delta should consist of :—

(a) Plant the whole area with shisham root and shoot cuttings 5' apart in April and May.

(b) Introduce *farash* shoot cuttings in between the shisham in the months of August and September. The stock will thus consist of a mixture of the two species. In course of time *farash* will be cut out where shisham continues to grow satisfactorily ; where shisham fails, *farash* will still be

there to form the crop. Thus the crop will be according to the suitability of the soil. The additional cost of planting *farash* will only be Re. 1-8 per acre which is nothing in consideration of the surety of stocking the area fully. Moreover if shisham survives, it will more than repay the additional cost.

IDENTIFICATION OF UNITED PROVINCES WOODS.

BY HIRA SINGH, P. F. S.

The following is a key to the identification with a hand lens (10 magnification) of 52 United Provinces woods :—

It is not claimed that the key is perfect or could not be improved upon, but it is hoped that it may prove of some practical use to forest officers and others interested in the utilisation of Indian woods.

The figures on the right hand side of the key refer to a further sub-division given against the corresponding numbers on the left hand side.

1. Wood without pores	2.
1. Wood with pores	8.
2. Resin canals present	3.
2. Resin canals absent or when present they are in tangential bands or groups	5.
3. Resin canals large distinctly visible with the naked eye	4.
3. Resin canals small not visible with the naked eye, wood lustrous and light	<i>Picea Morinda.</i>
4. Summer wood distinctly dark ; strong odour ; coarse textured, wood fairly heavy	<i>Pinus longifolia.</i>
4. Summer wood not conspicuously dark, fine textured, wood light	<i>Pinus excelsa.</i>
5. Tangential bands of resin canals absent, summer wood appearing as fine dark lines on the cross section	6
5. Tangential bands of resin canals present	7
6. Wood light brownish yellow giving a light aromatic odour when freshly cut, bitter taste, coarse textured	<i>Cupressus torulosa.</i>
6. Wood reddish brown, odourless, tasteless	<i>Taxus baccata.</i>

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|---|------------------------------|-----|
| 7. Wood light brownish yellow with strong characteristic odour also with an oily and smooth feel | <i>Cedrus Deodara.</i> | |
| 7. Wood whitish brown, odourless and with a rough feel | <i>Abies Webbiana.</i> | |
| 8. Ring-porous or semi-ring-porous wood | ... | 9. |
| 8. Diffused porous wood | ... | 16. |
| 9. Pores clearly visible with the naked eye | ... | 10. |
| 9. Pores scarcely visible with the naked eye ; wood rays extremely fine just visible with a hand lens ; wood fine textured, moderately hard, yellowish to dark brown with greenish tinge | <i>Pistacia integerrima.</i> | |
| 10. Vessels with dark or white gummy deposits | ... | 12. |
| 10. Vessels without any gummy deposits | ... | 11. |
| 11. Parenchyma forming a reticulum with the wood rays ; wood coarse textured, soft light and sometimes tends to become diffuse porous wood tylosis rarely present | <i>Cordia Myxa.</i> | |
| 11. Parenchyma forming a thin lining round the pores ; wood hard and fairly heavy, tylosis fairly abundant | <i>Tectona grandis.</i> | |
| 12. Tylosis rarely present ; vessels containing dark gummy deposits | ... | 13. |
| 12. Tylosis fairly abundant, usually completely occluding the pores ; gummy deposits white or yellowish white when present | ... | 15. |
| 13. Change from spring to summerwood abrupt | ... | 14. |
| 13. Change from spring to summerwood not abrupt with a tendency to form a semi-ring-porous character ; parenchyma forming a distinct halo round the pores ; white deposits rather abundant | <i>Morus indica.</i> | |
| 14. Wood lustrous yellow when freshly cut ; white gummy deposit not abundant ; fairly hard | <i>Morus serrata.</i> | |
| 14. White gummy deposits not present, dully yellow with greenish tinge | <i>Morus alba.</i> | |
| 15. Change from spring wood to summerwood very abrupt ; the spring wood forming a distinct zone in the early wood ; colour light reddish brown | <i>Cedrela serrata.</i> | |
| 15. Change from spring to summerwood rather gradual ; wood distinctly brick red or deep reddish brown colour | <i>Cedrela Toona.</i> | |
| 16. Wood with longitudinal resin canals usually containing white resinous contents, tylosis completely occluding the pores in the heartwood | <i>Shorea robusta.</i> | |
| 16. Wood without longitudinal resin canals | ... | 17. |
| 17. Wood rays aggregate or compound | ... | 18. |
| 17. Wood rays simple | ... | 25. |
| 18. Vessels arranged in radial lines or groups | ... | 19. |

- | | | | | | |
|---|-----|-----|-----|--|-----|
| 18. Vessels not arranged in radial lines or groups, Parenchyma forming a thin wall about the pores; Wood light and of light brown colour | ... | ... | ... | <i>Carpinus.</i>
<i>Alnus nepalensis</i> | |
| 19. Pores embedded in more or less a continuous band of parenchyma running between the rays | ... | ... | ... | <i>Quercus dilatata.</i>
<i>Quercus semecarpifolia.</i> | |
| 19. Pores embedded in patches of parenchyma but not forming a continuous or a regular band | ... | ... | ... | <i>Quercus incana</i>
<i>Quercus glauca.</i> | |
| 20. Rays in echelon showing ripple marks | ... | ... | ... | | 21 |
| 20. Rays not forming ripple marks | ... | ... | ... | | 25. |
| 21. Pores in cross section connected by tangential lines or bands of parenchyma which extend across a number of wood rays | ... | ... | ... | | 22. |
| 21. Pores not connected by lines of parenchyma which is only restricted round the pores forming a thin film; very fine wood rays; wood fine textured fairly hard | ... | ... | ... | <i>Pterospermum acerifolium</i> | |
| 22. Pores containing dark gummy deposits or white amorphous deposits | ... | ... | ... | | 23. |
| 22. Pores not containing any deposits | ... | ... | ... | | 24. |
| 23. Wood whitish pale. No distinction between heartwood and sapwood; rays just visible with the naked eye; pores occluded with white deposits; wood fairly hard | ... | ... | ... | <i>Holoptelea integrifolia.</i> | |
| 23. Sapwood whitish pale heartwood dull yellow to yellowish brown, rays not visible with the naked eye; pores sometimes contain dark gummy deposits, wood very hard | ... | ... | ... | <i>Ougeinia dalbergioides.</i> | |
| 24. Wood brownish yellow somewhat lustrous | ... | ... | ... | <i>Pterocarpus Marsupium.</i> | |
| 24. Wood dark red | ... | ... | ... | <i>Pterocarpus dalbergioides.</i> | |
| 25. Pores extremely minute not visible with unaided eye | ... | ... | ... | | 26. |
| 25. Pores visible with naked eye | ... | ... | ... | | 37. |
| 26. Pores not visible with a hand lens... | ... | ... | ... | | 27. |
| 26. Pores visible with a hand lens | ... | ... | ... | | 28. |
| 27. Wood rays extremely fine, not visible with a lens in the heartwood which is jet black; wood very heavy and hard | ... | ... | ... | <i>Diospyros Ebenum.</i> | |
| 27. Wood rays very fine, just visible with a hand lens, wood hard, very fine textured, yellow to pale yellowish white | ... | ... | ... | <i>Buxus semperferviens.</i> | |
| 28. Wood rays visible with the naked eye; wood yellowish white, sometimes with yellow streak; heartwood and sapwood not distinguishable, parenchyma in tangential bands | ... | ... | ... | <i>Casearia tomentosa,</i> | |
| 28. Wood rays not visible with the unaided eye | ... | ... | ... | | 29. |
| 29. Tylosis present | ... | ... | ... | | 30. |
| 29. Tylosis absent | ... | ... | ... | | 31. |

30. Very thin lines of parenchyma forming a reticulum with the wood rays, Pores in radial rows of 2 to 6 pores rather prominent in longitudinal plane; wood rather coarse textured ... *Bassia latifolia*
30. Parenchyma restricted in a thin film round the pores; vessels sometimes containing white amorphous deposits. Pores generally solitary only occasionally in pairs of two arranged in radial direction; wood moderately fine textured ... *Schleichera trijuga.*
31. Pores in rows of 2 to 5 arranged in radial direction very thin lines of parenchyma forming a sort of reticulum with wood rays which are very minute ... 32.
31. Pores not arranged in radial rows; parenchyma not forming a reticulum with wood rays ... 33.
32. Wood rather coarse textured, spongy (pores less numerous per unit of area) ... *Wrightia tomentosa* ...
32. Wood rather fine textured (Pores more numerous per unit of area). ... *Holarrhena antidysenterica.*
33. Parenchyma forming a halo round the pores ... 34.
33. Parenchyma not forming a halo round the pores ... 36.
34. Very fine pores just visible with a hand lens and embedded in extensive patches of parenchyma; wood light brown ... 35.
34. Pores clearly visible with a hand lens sometimes in radial or obliquely radial groups of 2 to 3; wood hard, fine textured, dull yellow ... *Anogeissus latifolia* ...
35. Fairly broad brownish red rays 75 to 85 per inch. *Acer caesium* ...
35. Fine wood rays, numerous per inch. ... *Acer oblongum* ...
36. Wood reddish brown ... *Stephegyne parvifolia.*
36. Wood yellow ... *Adina cordifolia* ...
37. Wood rays visible with naked eye ... 38.
37. Wood rays not visible with naked eye. ... 42.
38. Vessels containing dark gummy deposits. ... 39.
38. Vessels not containing gummy deposits ... 40.
39. Pores occasionally with white amorphous deposits in the heartwood ... *Acacia Catechu* ...
39. Pores without white amorphous deposits ... *Acacia arabica* ...
40. Pores usually arranged in radial rows of 2 or 3; thin lines of parenchyma forming a reticulum with wood rays; wood coarse textured ... *Hymenodictyon excelsum.*
40. Pores not arranged in radial rows ... 41.
41. Extensive patches of parenchyma between the wood rays which are generally continuous and broad 55 to 60 per inch; wood soft, light, dull brown, vessels very conspicuous on faces of board ... *Bombax matabaricum.*

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|---|---|-----|
| 41. Parenchyma forming a halo round the pores; wood rays not broad 105, to 110 per inch; occasionally intercepted by pores; wood hard, fairly heavy, heartwood dark brown, vessels conspicuous on faces ... | <i>Albizzia Lebbek.</i> | |
| 42. Pores appearing as 'eyelets' surrounded by parenchyma ... | ... | 44 |
| 42. Pores not appearing as 'eyelets' surrounded by parenchyma ... | ... | 43. |
| 43. Vessels not containing white deposits, wood dull yellowish, soft and light ... | <i>Trewia nudiflora</i> | |
| 43. Vessels containing white deposits, wood light reddish brown, hard and heavy ... | <i>Eugenia Jambolana.</i> | |
| 44. Parenchyma in addition to being round the pores also forming a terminal band on the outer face of the seasonal ring ... | ... | 45. |
| 44. Parenchyma not forming a terminal band on the outer face of seasonal ring ... | ... | 46. |
| 45. Parenchyma abundant about the pores which often coalesce, vessels sometimes containing dark gummy deposits wood dark brown ... | <i>Terminalia tomentosa.</i> | |
| 45. Parenchyma not very abundant round the pores which as a rule do not coalesce and are solitary; vessels containing white deposits, wood light brown ... | <i>Terminalia Arjuna.</i> | |
| 46. Pores connected by tangential bands or lines of parenchyma which are usually not continuous but invariably extend across a number of rays, heartwood dark brown with darker streaks; vessels on the faces of board fairly conspicuous and shining or lustrous ... | <i>Dalbergia Sissoo.</i> | |
| 46. Pores not connected by tangential bands or lines of parenchyma; heartwood brown sometimes dark brown, vessels on faces of board very conspicuous but dull ... | <i>Albizzia stipulata.</i>
<i>Albizzia odoratissima.</i>
<i>Albizzia procera.</i> | |

GORAKHPUR FOREST DIVISION.

BY M. P. BHOLA, I.F.S.

1. *Situation.*—Gorakhpur is the headquarters of the B. and N. W. Railway and is the easternmost district of the United Provinces being on the border of Nepal and Behar. The forests lie mostly in the north-east of the district in the Maharajganj Tehsil and are fed by three Railway lines. Gorakhpur-Nautanwa, Gorakhpur-Gonda loop and the Siswa-Bazar line. Gorakhpur can be reached from the west *vid* Lucknow, from the east *vid* Katihar, the eastern terminus of the B. and N. W. Railway and from the south *vid* Allahabad and Benares.

2. *Interesting Historical facts.*—Although now completely isolated, the Gorakhpur forests are geographically a part of the great belt of sal forests which extends throughout the United Provinces in the submontane districts. The history of the forests may be divided into six different periods.

- (a) *1801 to 1830.*—The period of exploitation and *jungle burry pallas*. During this period the land was given away by the East India Company to private individuals for clearing up and cultivation, but little was done.
- (b) *1830 to 1855.*—The period of big grantees. Here again large tracts of forest land was given to private individuals on the condition that it was cleared up for cultivation during a definite period—any portion left uncleared lapsed to the Government and these form to-day our Government Reserved Forests.
- (c) *1855 to 1875.*—By this time the advantage of keeping certain areas under forest was realized. Small grants were also given out which were kept as forests and properly managed.

Contracts for sal resin were given out and the disastrous effects on timber produced by this tapping can be seen to the present day.

- (d) *1875 to 1893.*—In 1876, the reservation of the forests under the Indian Forest Act began and in the same year Mr. Amery, who was a trained forest officer, made a Working Plan. His system was clear felling a definite area each year, but due to the large amount of timber put suddenly on the market prices fell and the plan failed. In 1878 a fresh plan was consequently drawn up by Mr. Grieg, the main idea of which was to keep 160 clean stems per acre and to fell the rest this plan was in force till 1893.
- (e) *1893 to 1914.*—In 1893 Mr. Har Sarup made a plan in which the southern forests were put under coppice with standards system on a 20-year rotation and the northern forests under improvement fellings.

(f) 1914 to 1924.—In 1914 Mr. Marriot drew up a plan, which with certain amendments effected later, prescribed clear fellings with regeneration from coppice in the southern forests and improvement-cum-selection fellings in the northern forests. This Plan remained in force till 1924, when it was revised by the writer.

3. *Type of country*.—The forests are of Tarai type and the northern forests are not very far from the Nepal foot-hills.

The country is flat and drainage imperfect; the height above mean sea level being about 300 feet and the distance to the sea about 600 miles. The climate is damp, but more equable than other parts of the United Provinces. The rains break about the middle of June, the rainfall being about 54 inches annually.

4. *Geology*.—The whole district is composed of the Gangetic alluvium, the sub-soil being mostly hard clay badly aerated with little loam at the surface. At a depth of about 20 feet the deposit is practically pure sand, a pan of *kanker* occurring sometimes between the clay and sand.

5. *Forest Roads*.—The forests are well provided with separate cart and motor roads which join on to good District Board metalled roads. Supplies are mostly obtained from Gorakhpur, but bazars are held at Nichlaul, Chauk, Lachhmipur, Campeirganj, Pharenda and other places where rice, ata, dall, meat, ghee, vegetables, etc., are obtainable.

6. *Flora*.—Sal is the chief timber producing species; next in importance comes *jaman* (*Eugenia Jambolana*), which is the poor man's timber in this district. *Asna* (*Terminalia tomentosa*) occurs in small quantities but is used only for fuel.

7. *System of management*.—Under the present plan (1924-25 to 1933-34 Wood and Bhola) the general system of management is the clear fellings by area and regeneration by coppice shoots. In Felling Series I of Working Circle I (Tilkonia and Banki Ranges) however about 10 trees per acre are retained until the young shoots are safe from frost. The standards are removed in the 5th year after fellings, in the first thinnings. The rotation has been fixed at 40 and 50 years for the southern forests and 100

years for the northern forests according to the demand for timber of various sizes. Due to the northern forests having been placed under clear felling for the first time under the present plan, it was found that there were not enough carts in the district to export the timber; a permanent forest tramway was made to export timber and fuel to the rail-head at Lachhmipur (B. and N. W. Railway). This tramway was built at a cost of Rs. 3½ lakhs and brings in a direct revenue of Rs. 50,000 a year. A very popular and interesting method of completing regeneration in areas where coppice fails is the *taungya* system, which has been successfully carried out in this division for the last 5 years and there are now more than 2,000 acres under *taungya*. Smaller failures where *taungya* can not be profitably practised are planted up with teak which grows very well in the division.

The average annual (last 3 years' average) gross revenue of the division is Rs. 8,87,000 expenditure Rs. 1,48,000 and surplus Rs. 7,39,000.

8. *Produce extracted*.—The forests are worked very intensively, all timber, offcuts and even branch wood being taken out by the contractors. No definite size of timber except sleepers, are sawn, of which 50,000 Meter Gauge are supplied annually to the B. and N. W. Railway.

The only minor produce is thatching grass for which there is a heavy demand owing to a very heavy population in the district. The revenue from grass is about a lac of rupees a year.

9. *Habits of people living near the forests*.—The people living in villages near the forests are generally agriculturists, who besides the profits from field crops, earn some money by working in the forests as sawyers, wood-cutters and coolies on various forest works. They own large herds of cattle much above their agricultural requirements and for which grazing is provided in the reserved forests on payment. The staple food of the villagers is rice and fish.

10. *Shikar and fishing*.—The fauna of Gorakhpur is poor due to the forests not being continuous with those of the Nepal hills and being surrounded by a heavy population. There are no

bears or sambhar, but occasionally towards Domakhand tigers find their way in from Nepal. Pig and nilgai are plentiful and there is fair number of chital; and also some panthers. There are wild dogs too. Crocodiles are plentiful in nalas and small rivers and duck and snipe shooting is excellent.

Fish is plentiful in the jhils, nalas and rivers in the division.

**A FEW OBSERVATIONS ON THE FLOWERING OF
KYATHAUNGWA (BAMBUSA POLYMORPHA, MUNRO).**

By F. W. T. BODEKAR, P.F.S., BURMA.

During the 1929-30 open season the following was observed in the Yonbin and Palwe Reserves of Pyinmana Division, Burma.

In about the beginning of February a few scattered clumps of *kyathaung* were in bloom in Compartment 20, Yonbin. The forest in these places was barely of the moist upper mixed deciduous type as the *kyathaung* were about 4" or less in diameter and from 40' to 60' in height, and amongst the tree species were *Terminalia tomentosa* and *Terminalia Chebula*.

The flowers were confined to the extremities of the culms and where they appeared leaves were often absent. Stamens were found in the new flowers which were examined, and as small bees were hovering persistently around the inflorescences it was felt that pollination had not been completed. There were no culms of the last growing season in any of these clumps.

Compartment 93, Palwe had examples of both sporadic and gregarious flowering, the latter involving areas from about half an acre to perhaps 50 acres or more. Here again this phenomenon was confined generally to the drier *kyathaung* bearing tracts, as on the moister slopes and in the valleys the *kyathaung* clumps bore no traces of flowers and had their usual quota of new culms.

The gregarious flowering appears to have occurred in 1928 as the clumps were just dying and the ground was littered with seedlings about 6" high. Amongst these clumps was one from

whose rhizomes had developed a bunch of whippy shoots about 4' 6" in height. Most of these shoots bore flowers.

When this compartment was first visited in December the 'busy bee' was very noticeable among the flower bearing clumps. Towards the end of February pollination had apparently eased loff as several flowers were without their stamens and the bees were not so conspicuous.

**LANTANA IN NORTHERN INDIA AS A PEST AND ITS
PROBABLE UTILITY IN SOLVING THE COWDUNG
PROBLEM.**

BY MOHD. HAKIMUDDIN, P.F.S.

1. *Introduction in the United Provinces.*—*Lantana Camara* is already a well known tropical American shrub which is said to have been first introduced in Calcutta as a hedge plant early in the last century. Unfortunately in the same way it was introduced into the United Provinces some 25–30 years ago at Kathgodam in the Naini Tal District when probably its disadvantages were not fully realised.

2. *Early stage in 1911.*—I first saw this shrub in these provinces in 1911 when *Lantana* was still within bounds and round about Kathgodam and Haldwani limited to field hedges and bushes from 20 to 60 feet apart in fallow and pasture lands. It had not spread more than a few miles radius from the place of its origin and was so sparse that it used to afford good hare and partridge shooting.

3. *Condition in 1930.*—Within a period of 19 years it has spread up to Bhimtal in the hills, beyond Ramnagar in the west and to Tanakpur in the east, and similar distance south in the Tarai and Bhabar Government Estates. That is, it has now extended almost in a thick continuous mass to an average radius of about 25 miles round Haldwani, in agricultural, fallow and pasture lands and also in the scrub and miscellaneous forest. In sal forest it is generally sporadic probably due to dense shade or some unknown reason, since this is not a general rule, as it

does not mind at all the very thick shade of other species and even in sal forests it is as thick in places as in the open.

4. *The sad plight of the agriculturists.*—Large areas of irrigated agricultural lands which were in 1911 fine productive fields and in many cases with masonry boundary walls and fruit trees, have been abandoned, because it is beyond the cultivator's limited means to fight against the fast encroaching *Lantana*. He is deprived of the grazing grounds for his cattle and fallow lands for the extension of cultivation. This is not the end, *Lantana* has spread up to his very door and provides the finest shelter for his enemies who take a heavy toll of his crops and cattle. It has further permanently closed all the paths and short cuts from holding to holding and village to village. It harbours mosquitoes, snakes and other vermin in such numbers that the life of the cultivator in *Lantana* affected areas has been rendered most miserable. Every time the cultivator prepares his fields for sowing crops, he takes special care to dig, uproot and burn all *Lantana* plants in the field. Yet after a month or so he finds to his utter disgust and disappointment that it is again coming up with his crops. Cutting is of no avail while digging, uprooting and burning at this stage is injurious to the field crops. By the time the crops are ready the *Lantana* is flowering and boldly challenges the cultivator. In short, the cultivator has a long list of grievances against *Lantana* with no remedy or place to appeal, except that he unwillingly has, to hand over charge of his holding which was once prosperous to the full enjoyment of *Lantana*.

5. *Why Lantana spreads so rapidly and completely.*—The reasons as to why *Lantana* has spread so quickly are briefly given below :—

- (1) It accommodates itself in all sorts of climate from plains to lower hills.
- (2) It thrives well in all kinds of locality whether frosty, damp or very dry.
- (3) It grows without the least difference both under shade and direct sunlight.

- (4) It has no scruples for any kinds of soil from pure sand to pure clay as well as pure gravel in old dry river beds.
- (5) It flowers and fruits throughout the year abundantly. Buds, flowers, ripe and un-ripe fruits being found on the same plant in thousands all the year round.
- (6) Innumerable varieties of birds and nocturnal animal feed on their fruits day and night and pass the seed uninjured with their excreta and sow them broadcast on a wide range in all sorts of localities.
- (7) It reproduces by coppice shoots profusely when cut or lightly burnt. So no amount of cutting or even burning can destroy it completely once it is established. It does diminish by cutting or uprooting and burning for a year, or at the most two only, and recovers completely in the third year if the same operation is not repeated.
- (8) It reproduces by root shoots also. Uprooting by digging has been employed to destroy *Lantana* from fields and other places but it invariably produces shoots from any portion of the roots which may have been left in the ground.
- (9) *Lantana* grows to an average height of about 10' and about 12" in thickness in a thick bush and getting a handy support it has been seen to climb trees over 30' in height. The branches and foliage make such a thick mass that nothing can pass through, nor can light get in. In the first place no seed can germinate under its thick shade and if it does, it never thrives.

With the above extraordinary qualifications *Lantana* can easily oust many species, be it in the forest or outside.

6. *Methods to destroy or diminish it.*—The only method so far known to eradicate it, is to dig it up completely with roots,

and burn each bush at the very place where it was growing, so that every bit of the roots may be burnt or so damaged as to render them incapable of giving out shoots. This method can only be used when *Lantana* is found in small areas; it is very expensive when large areas are to be dealt with, the cost being Rs. 7 to Rs. 12 per acre. Moreover, this method provides prepared ground for the new seed from the surrounding *Lantana* bushes.

The second method is to burn it in May when it is very hot and dry. *Lantana* bushes generally have lower twigs and branches dead and dry on account of their own thick shade, and besides there is always a good layer of dry leaves on the ground, so that it burns completely. During the first rains after burning, it generally throws up scanty shoots which are straight and very probably would not burn next summer for want of sufficient dry combustible material. During the second rains it again becomes fairly thick and would certainly burn in the third summer. This is the cheapest, easiest and most practical method of reducing or at least keeping the *Lantana* within bounds, but the villagers cannot in every case burn it for fear of the fire getting into the reserved forests.

7. *Probable utility of Lantana.*—*Lantana* is no doubt a curse and may even prove ruinous to the interests of cultivators and landowners in about 25 years time from its introduction, but nature has not created anything without use. The habit of *Lantana* may prove a blessing for districts of the Agra Civil Division, Rajputana Mewar and Sind desert lands round habitations, as fuel reserves, where the scarcity of vegetation has rendered it necessary to substitute cowdung in place of fuel at the sacrifice of field manure and where the summer is unbearably hot. If *Lantana* can grow there, it may be a boon and deserves a fair trial. Although it is said to thrive naturally in areas with a rainfall of over 30", but there is no reason to believe that it would not thrive in localities with a less rainfall, because we find it growing well in every dry old river beds in the Bhabar with a temperature of over 112°, and now-a-days we see many species being successfully introduced out of

their habitat in unfavourable climates, and that is, why I say it deserves a fair trial. It is said to be cut back by frost even under the *shisham* in some places, but in these provinces the severe frost does not affect it even in the open. The expected advantages of *Lantana* in the above mentioned dry localities may be enumerated as under:—

- (1) It will provide excellent fuel for the population at a low price from the second year of its introduction.
- (2) Cowdung will be spared to be put to its right use and thereby enhance the fertility of fields and consequently the prosperity of the agriculturists.
- (3) It will provide means of livelihood to thousands of starving people who can after a day's labour bring a head load of fuel and sell it.
- (4) If it thrives in those dry and hot localities and spreads in the arid and barren stretches of land as it does here, it is bound to have a very favourable effect on the climate.
- (5) Its thick shade will retard the evaporation of moisture from the soil and thus lower the intensity of heat and hot winds and eventually in course of time will have a tendency to raise the water level in the soil.
- (6) It will provide food and shelter to millions of birds and animals. Amongst the domestic animals, goats, pigs and cows have been seen eating the bunches of flowers and young fruits of *Lantana* in localities where ample food of other kind is available for them, so it may also provide fodder to domestic animals to some extent.
- (7) It is not likely that *Lantana* will ever get out of control in those dry localities and moreover its utility as fuel will always keep it within bounds which is not the case here. It is, therefore, not too much to expect that with the improvement of moisture and fertility in the soil, other vegetation may also find its way

under the protection of *Lantana*, and gradually improve the general outlook, climate, rainfall, temperature, water level and fertility of the soil. Thus *Lantana* which is a curse in fertile localities may prove a blessing in dry and desert lands.

- (8) Referring to the detailed article of Mr. M. D. Chaturvedi on "The Problem of Cowdung", may I suggest the name of *Lantana Camara* for inclusion in the list of species given on page 163 of the "Indian Forester" for April 1930.
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SAW FELLING.

By H. H. McC.

The Saw is probably the most unpopular tool in the carpenter's bag and similarly in the forests, the ordinary coolie invariably prefers to fell a tree entirely with an axe or even with the primitive *kun* rather than use a cross-cut saw for even a part of the operation.

Sawing calls for no skill, is monotonous and if not properly done is very fatiguing, the muscles of the arm being in an unvarying state of compression throughout.

Felling with an axe, however, results in waste of several cubic feet of valuable timber. Consequently, in Burma, the Forest Department insists that felling should be done as far as possible with the cross-cut saw. Another point insisted on is that felling should be done as close to the ground as possible. This was necessary as the ordinary felling coolie has a not unnatural objection to buttresses and often prefers to go to the trouble of building a platform 6' or so high and wield his axe from there.

In one forest at all events, namely Gangaw, both these difficulties have been overcome by the introduction of a special method of using the cross-cut saw, devised by the local Forest manager of the Bombay-Burma Corporation:—

This method may be summarised:—

- A. The saw must be kept absolutely horizontal.
- B. The saw must only be pulled, never pushed.

When one man is pulling the saw towards him the other must simply support his end of the saw to keep it horizontal, he must never try and push it with the idea of helping on the good work. Incidentally it is this mistaken idea that pulling and pushing at the same time hastens the work, that makes cross-cut sawing so difficult. The saw gets buckled, calling for extra work and direction is lost.

The work should be carried out in this order:—

1. It is most important that the saw cuts should be begun exactly right. A little time and trouble spent at the start will save a great deal of time and trouble in the end. The first step is to put round the tree a piece of string or a *ngi* horizontally exactly where the sawing should be done. A line should then be drawn with a piece of charcoal along the string. Care must be taken to keep the saw cut exactly along this line.

2. Having decided in which direction the tree is to be felled, the front saw cut should be started at right angles to this direction. The men must be on the same level, preferably sitting on the ground facing each other. The front saw cut should reach the middle of the tree, still remaining exactly at right angles to the direction in which the tree is to fall.

3. The back cut should be carried out in the same way. As the cut approaches the front cut iron wedges will have to be put into the cut behind the saw, just sufficient to allow a free use of the saw. A correctly felled tree will not fall till the 2 cuts meet exactly in the middle of the tree. It will then fall leaving a smooth top to the stump without any broken wood in the centre. With a leaning tree, however, it sometimes happens that the fall takes place before the cuts meet, leaving a broken piece in the middle and if not held up by wedges the tree may be badly split. The falling of the tree should never be hastened by the use of wedges, but on the contrary, wedges should be used to hold up the tree as long as possible.

4. The system sometimes adopted of having the front and back cuts on different levels is incorrect, and so is the use of the axe in guiding the fall. The top of the stump should be perfectly

level. The axe should not ordinarily be used at all. Sometimes, however, where the tree is large and unshapely, protruding buttresses should be cut away with the axe where the saw cuts are to take place.

5. Men who have been trained in this method take a pride in producing perfect stumps and would never revert to the axe. When saws are kept sharp and teeth correctly set, the method described not only conforms to the conditions laid down by the Forest Department but is actually easier than any other.

[We do not think that method (A. and B.) was devised by local manager of the Bombay-Burma Corporation. It was probably devised shortly after the introduction of the first cross-cut saw. In steep country an axe is useful because with the saw alone it is almost impossible to direct the tree.—HON. ED.]

REFRESHER COURSES IN INDIAN LANGUAGES.

Extract of a letter dated May 15, 1930, from the School of Oriental Studies, London Institution (University of London), Finsbury Circus, London, E. C. 2, to the Secretary of State for India.

"I have the honour to request that the Government of India may be asked to bring to the notice of all their officers the facilities provided at this School for 'refresher' courses in Indian languages, of which they might avail themselves when on ordinary or study leave. Excellent teachers are available, not only in Urdu, Hindi, Bengali, Pushtu, Punjabi, Marathi, Gujarati, Kanarese, Telugu, Tamil, etc., but also in Phonetics, Methods of Language Study and Comparative Religion. When an officer is on long leave, and I believe many would welcome the opportunity of pursuing further studies of the vernacular, if they only knew that such study would be possible at the School of Oriental Studies."

EXTRACTS.

A DIPTEROCARP FROM BORNEO.

Striking, too, are the *dipterocarpaceae*, which show great variety of form in Borneo. They are easily recognized by their large leaves and winged fruits. One of the species, the "engkabang" of the Malays and Dyaks (*Shorea falcifolia*), is the most profitable tree for the natives. Its fruits, which are formed every third and fifth year on the tree, contain a high percentage of fat. The tree is very abundant along the river banks, and bears masses of blossom, whilst at the proper season it is weighted with bright fruit in such quantities as to change the appearance of the tree to light red. Millions of winged nuts fall down into the water and float seawards. Men, women, and children all turn out, wade into the shallow rivers with nets and sieves and catch the flying fruits, which, when boiled, yield a fat content of no less than 32 per cent. The fat, which looks like tallow and has a not unpleasant aroma, is preserved in bamboo vessels and

is much appreciated as a tasty and nourishing addition to the sparse daily diet.

Forest Life and Adventures in the Malay Archipelago by Dr. Eric Mjöberg. George Allen and Unwin Ltd., London.

AGRICULTURE AND FORESTRY.

Occasionally a complaint is heard that agricultural land is being taken for afforestation and that useful land is losing productivity. Here and there a landowner may have created a small plantation for amenity purposes, but there is really no competition for land between agriculture and forestry.

Few timbers can stand good land. In the first place the agricultural value is too high, and, secondly, timber, especially the conifers, is none the better for rapid growth on rich ground. Even hardwoods give the best commercial return on the poorer agricultural soils. The success of oak on the East Anglian drift sands is a case in point, and so are the beech woods of Buckinghamshire and Savernake Forest on the thin chalk of Wiltshire.

Most of the new planting undertaken by the Forestry Commission is directed to the supply of coniferous timbers. The new forest of Thetford Chase, running to some 80,000 acres, is not depriving agriculture of any useful land, not at any rate in this era of low corn prices. These light, sandy wastes can be turned to no better use than timber production.

(*The Field.*)

EMPIRE FORESTRY ASSOCIATION.

Sir Peter Clutterbuck presided at the annual meeting of the Empire Forestry Association at the Surveyors' Institution, Great George-street, yesterday.

The Prince of Wales, president of the association, sent a message, in which he said:—"In the course of my travels, I have been able to appreciate the value of the services which the association renders to Empire Forestry, and I am very glad to see that the membership has been increased by no less than 50 per cent. in the past year, and that financially the association is now paying its way. I congratulate the association on the publication of the first number of the Empire Forestry Handbook, and I am sure that this handbook will not only be most useful as regards our trade in timbers, but that it will be, also, a valuable link between the thousands of forest officers scattered throughout the Empire. When I presided at your annual meeting in 1926 the total membership was only 571. This year, thanks to notable additions from Burma and South Africa, your members number 1,215."

In conveying its thanks to the Prince for his communication, the meeting congratulated him on receiving a gold medal for his exhibit in the Forestry Section at the Bath and West Show at Torquay on Thursday.

PRESERVING BRITISH TIMBERS.

Sir Peter Clutterbuck, in presenting the report, stated that the association had a deficit balance of £600, of which, however, £493 was owing to the association from the life subscription account. The total membership was now 1,258. At the beginning of the year, he continued, the British Wood Preserving Association was formed. Forestry would be affected in some measure, as a prolongation of the life of timber was equivalent to an increase in the supply. The new association ought also to be able in the next few years to promote home-grown timbers. Many British timbers now could not be sold, or else were sold at very small rates, because their life under present conditions was very short. If they could be treated in some way to give them a fair life, there seemed to be a great scope for home-grown timbers.

He stated in conclusion that he was thinking out a proposal for providing a London home for the members of the association, where forest officers could meet and enjoy certain amenities, such as a library. It might be very difficult to do justice to the association unless it had a good many thousands of pounds over and above what came in the ordinary way. It might take some years to carry out the scheme, but he was hoping to make a start.

The Duke of Devonshire and Lord Novar retired from the Governing Council and Lord Lovat, Lord Clinton, and Dr. John Sutherland were added. Sir Peter Clutterbuck was re-elected chairman.

(*The Times.*)

PAPER COMPANY WOUND UP.

Compulsory winding up of the Punjab Paper and Pulp Company, Ltd., was ordered in the Lahore High Court to-day by a bench consisting of Mr. Justice Tekchand and Mr. Justice Bhide on the application of Mr. Homi Rustomji, Pandit Bishennarain and various other advocates who appeared for the creditors.

Sir Motisagar appeared for the labourers in the employ of the Company and Mr. Carden Nod appeared for the Company.

In the course of their judgment their Lordships remarked that the Company was indebted to various persons to the extent of Rs. 60 lakhs, the principal creditors being Lloyd's Bank, the Foundation Company, and the People's Bank of Northern India. The judges held that the Company was unable to pay its debts; that there was no reasonable chance of its being re-started, that every day's delay in passing final orders was injurious to the interests of the creditors as well as the share-holders and that in the circumstances it was inevitable that it must go into liquidation.

Lala Mulhraj Bhalla, Managing Director, Punjab National Bank Limited, and Mr. Norman Edmunds, Barrister, were appointed as joint official liquidators.

(*The Pioneer.*)

BLUE POPPIES.

Ever since the first of the Asiatic blue poppies was discovered in Sikkim by Hooker about 80 years ago, they have exercised a magnetic spell over gardeners. Their appeal, it is true, has never been to the multitude, because hitherto they have needed more managing than the multitude is disposed to devote to such things; moreover, like most biennial plants, they are here to-day and gone to-morrow, and so have to be continually renewed. During the last few years, however, the blue poppies have taken a new lease of life from the accession to their ranks of a Tibetan variety, which Kingdon Ward introduced some years ago and called after Colonel Bailey, then British Resident at Gangtok, who originally discovered it. Botanically the plant is *Meconopsis betonicaefolia* var. *Baileyi*, and usage will probably shorten it to *Baileyi* without much risk of confusion with another variety of the same name, more lovely but difficult to grow out of doors.

The common saying that a plant is as easy to grow as a cabbage is not so inapplicable to this poppy as to the rest of the family, and, though it lacks something of the elusive quality of the blue poppy of Kashmir, *Meconopsis aculeata*, which is a will-o'-the-wisp in most British gardens, it is, none the less, a first-rate garden plant, easily raised from seeds, which it yields abundantly. If fine weather prevails they should be ripe for gathering in about seven weeks' time, and may be sown then. Those who already have this poppy will find that if the ground about the roots is not forked in spring, but is left undisturbed, as the ground about the roots of good plants should be, seedlings will spring up of themselves where the seed falls. That is more than can be said of most Asiatic poppies. In a year like this, when there is ample moisture in the ground, this poppy grows about a yard high and is correspondingly flowery; but in a dry season the growth will be stunted and less flowery; and, on the whole, a half-shady place is better than a full exposure to the sun. The fact that the poppy sometimes throws outside shoots at the root, which persist for a second, or even a third, season, has, no doubt, led to the notion that it is perennial, but the habit is exceptional and the plant is properly regarded as biennial. The poppy with sky-blue flowers and a perennial existence has yet to be found. Like so many other blue poppies, and for reasons which are obscure, this variety is sometimes uncertain whether the colour of its petals will be the loveliest shade of sky blue or whether they will be smirched by a disfiguring infusion of red; and until the buds burst to let what looks like a bundle of crumpled silk take shape as a perfect four-petalled flower, one cannot be certain of the tint.

Of the more manageable blue-flowered species of *Meconopsis* other than the variety *Baileyi*, that called *latifolia* is probably the least subject to these irritating lapses of colour, and those to whom it is a stranger should try it. With the tall-growing *M. Wallichii* and—a truly noble poppy—the

less tall variety, *Baileyi*, already referred to, and the dwarfier *M. latifolia*, they will have three beautiful plants with which they may well be content, leaving the others to specialists for whose cultural skill they are a worthy match. Success with the lovely but ephemeral poppies like *M. aculeata*, *sinuata*, *grandis* and *simplicifolia* var. *Baileyi* depends largely on the season, and so, in this wonderful year, they are making a brave show which may easily lead the innocent astray. The serenity of their colouring provides a pleasant antidote to the muddy colouring of some other species like *M. Pratti*, which is all too often held out as a blue poppy and is not worth troubling about. Amateurs who buy plants of these things from nurserymen should not blame the dealer if the petal colour proves disappointing, for no one can be sure of it beforehand.

(The Times.)

APPLICATIONS FOR FOREST APPOINTMENTS.

H. M. Forestry Commissioners invite applications for the following appointments:—

Forest Officers (probationary) and Estate Officers (probationary) at inclusive salaries at the rate of £300 per annum. Four appointments will be made. The posts are temporary, non-pensionable, and may be terminated on one month's notice, but after a period of probation of not less than two years may lead to established Grade II. District Officer posts on a scale £230-15-£400, with cost of living bonus in addition at Civil Service rates. At the present time this addition results in a scale of £336-£547 inclusive. There are higher grades—viz., Grade I. District Officer, £400-15-£500, plus bonus, and Divisional Officer, £600-25-£800, plus bonus.

Candidates who are selected for appointments may be required within the period of probation to undertake at their own expense one year's course of study at the Imperial Forestry Institute, Oxford.

Candidates must be between the ages of 21 and 30 on the 16th June, 1930 (provided that any period of Army, Navy, or Air Force service between 1/8/1914 and 31/12/1919 may be deducted).

Candidates for Forest Officer posts must have passed an examination qualifying for either a University degree in Forestry or a University diploma in Forestry; and candidates for Estate Officer posts must have passed the qualifying examination for the fellowship of the Surveyors Institution. Preference will be given to candidates who served in H. M. Forces in the Great War.

Applications on the appropriate forms to be obtained from the Secretary, Forestry Commission, 22, Grosvenor-garden, London, S. W. 1., must reach him not later than the 16th June, 1930.

(The Times.)

BAMBOO CUTTING RIGHTS.

Colony and Protectorate of Kenya. Tenders invited for Bamboo Cutting rights for manufacture of paper pulp. Area not less than 50,000 acres in the Kikuyu Escarpment Forest Reserve. Licence for 20 years.—For further particulars apply H. M. Eastern African Dependencies Trade and Information Office, Royal Mail Building, Cockspur street, S. W. 1.

(*The Times.*)

THE MUNTJAC.

SIR,—I have had considerable facilities for shooting which has extended over a very long period but, notwithstanding, it has not fallen within my experience, until recently, to see an entirely smoky black specimen of the species which, ordinarily, is characterised by having creases between the facial ridges dark brown with a dark line running up the inside of each frontal pedestal; all the rest of the head and upper parts a bright rufous bay; chin, throat, inside of hind legs and beneath tail, white, some white spots in front of the fetlocks of all four legs; forelegs from the shoulder downwards, the legs under the tarsal joints, and a line in front of hindlegs, dark blackish-brown. This being so, I shall feel greatly obliged by you, or your readers having knowledge of the subject, kindly advising me as to whether the almost full grown doe now in my possession and secured from Sikkim is a freak of nature, or otherwise. I enclose my card and thank you in anticipation.

BLACK MUNTJAC.

(*The Statesman.*)

SARAWAK RAJAH'S GIFT TO THE IMPERIAL FORESTRY INSTITUTE.

It is officially announced that the Rajah of Sarawak has decided that the remaining £25,000 of his gift of £100,000 to the British Government shall be allocated to the Imperial Forestry Institute.

(*The Pioneer.*)

INDIAN FORESTER.

OCTOBER 1930.

PLANTATION-GROWN TIMBER.

BY L. N. SEAMAN, OFFICER-IN-CHARGE, TIMBER TESTING
SECTION, FOREST RESEARCH INSTITUTE.

Some time ago a note appeared in *Indian Forester* on the effect of growth rate on the strength of wood.* It dealt with work which had been done in Canada and at Dehra Dun, and outlined a fairly general relation, in the case of conifers and ring-porous dicotyledons, between the density and strength of the wood and the rate of growth in stem diameter as indicated by the thickness of the seasonal growth layers. Data collected up to that time were not conclusive in the case of diffuse-porous dicotyledons.

Expressed very briefly, it was shown that, with respect to the production of dense strong wood, conifers had an optimum growth rate which was relatively slow, and ring-porous dicotyledons one which was relatively rapid. In other words, those conditions which induced moderately slow diameter increase in the coniferous species examined also resulted in the formation of dense strong tissues, while the strongest and heaviest wood in the ring-porous dicotyledons tested was formed under conditions which were favourable to rapid growth in stem thickness. These observations, of course, relate to the ordinary run of trees cut for

* "Relation of Rate of Growth to Strength in Timber", Seaman, *Indian Forester*, December, 1926, pages 619—625.

timber, and not necessarily to plants which have been subjected to very unusual treatment.

Similar investigations have been conducted, or are still in progress, elsewhere, and a recent interesting addition to the literature on the subject is "The Application of Silviculture in Controlling the Specific Gravity of Wood."* This work adds significant data in relation to some diffuse-porous species of temperate America. The results of observations on 25 poplar and 44 maple trees are summarised in the following statement, quoted verbatim :—

"In the diffuse-porous woods studied, less contrast existed in the portion of the annual rings formed during the earlier and during the later parts of the growing season, so that the first gradual retardation of radial growth may not be reflected in the specific gravity of the wood. A continuation of adverse growth conditions, however, resulted not only in the formation of narrow rings but also in the formation of rings more porous, so that the wood became correspondingly lighter."

Data from forty-five trees covering nine species of diffuse-porous woods examined at Dehra Dun are in agreement with the first part of this statement; growth rates varying from five to fifteen rings per inch showed no marked difference in the specific gravity of the resulting wood. The material available here offered no example of trees which had suffered great and prolonged changes in rate of thickness increase, so that information is lacking as to the effect of long continued adverse growing conditions, but there would seem to be no reason to expect results differing from those mentioned in the latter part of the above statement.

The application of the results of these investigations is of great importance. It is quite possible to influence the growth rate of trees. From the point of view of a quick yield a rapid growth is desirable. For the production of dense strong wood three cases have to be considered. With conifers a moderately slow rate is best; with ring-porous dicotyledons a relatively rapid growth produces the strongest wood, and with diffuse-porous

* Technical Bulletin No. 168, B. H. Paul, U. S. Department of Agriculture.

dicotyledons, while data are still scarce, there is a strong indication that wood grown at a relatively rapid rate is superior. In short, there is no evidence in favour of slow growth for any timber species except the conifers.*

Other aspects of wood quality must, of course, be kept in mind. Rapid diameter growth obtained by thinning sufficiently to permit persistent branches on the stem, and consequently knotty wood, is obviously undesirable. For the majority of our dicotyledonous trees the best returns are to be expected from the most rapid growth consistent with the production of clear, straight-grained timber.

Data are now available which afford very definite and very practical proof of the advantage of the application of this principle in the case of one Indian ring-porous species, *Tectona grandis* (Teak). From time to time the question has arisen of the relative quality of plantation-grown and forest-grown teak. In 1911, Forest Bulletin No. 3 by R. S. Pearson, reported the results of comparative tests on plantation-grown and forest-grown teak from Burma. The data and the conclusions in this Bulletin are extremely interesting. There were certain differences between the specimens of the two kinds of teak. For example, the plantation-grown teak used in transverse tests was in the form of specimens $2\frac{1}{2}'' \times 2\frac{1}{2}'' \times 23''$, while the forest-grown teak was cut $2'' \times 2'' \times 22''$. The plantation-grown teak contained an average moisture content of 10.83 per cent. and the forest-grown teak of 9.89 per cent. The plantation-grown teak was felled green, while the forest-grown teak was felled in the usual way after girdling. All these differences tend to make the observed test results on the forest-grown teak appear rather higher than if the differences had not existed. In spite of these variations, all favourable to the forest-grown teak, Mr. Pearson says in his "Conclusions", ".....it may provisionally be assumed that as regards the strength of natural and plantation-grown teak from the Zigon Division there is little difference, and though in the case

* Excessively slow growth is not desirable with conifers. The best samples examined at Dehra Dun grew at about twelve rings per inch, but double that rate (six rings per inch), produces excellent wood provided it does not contain too many knots;

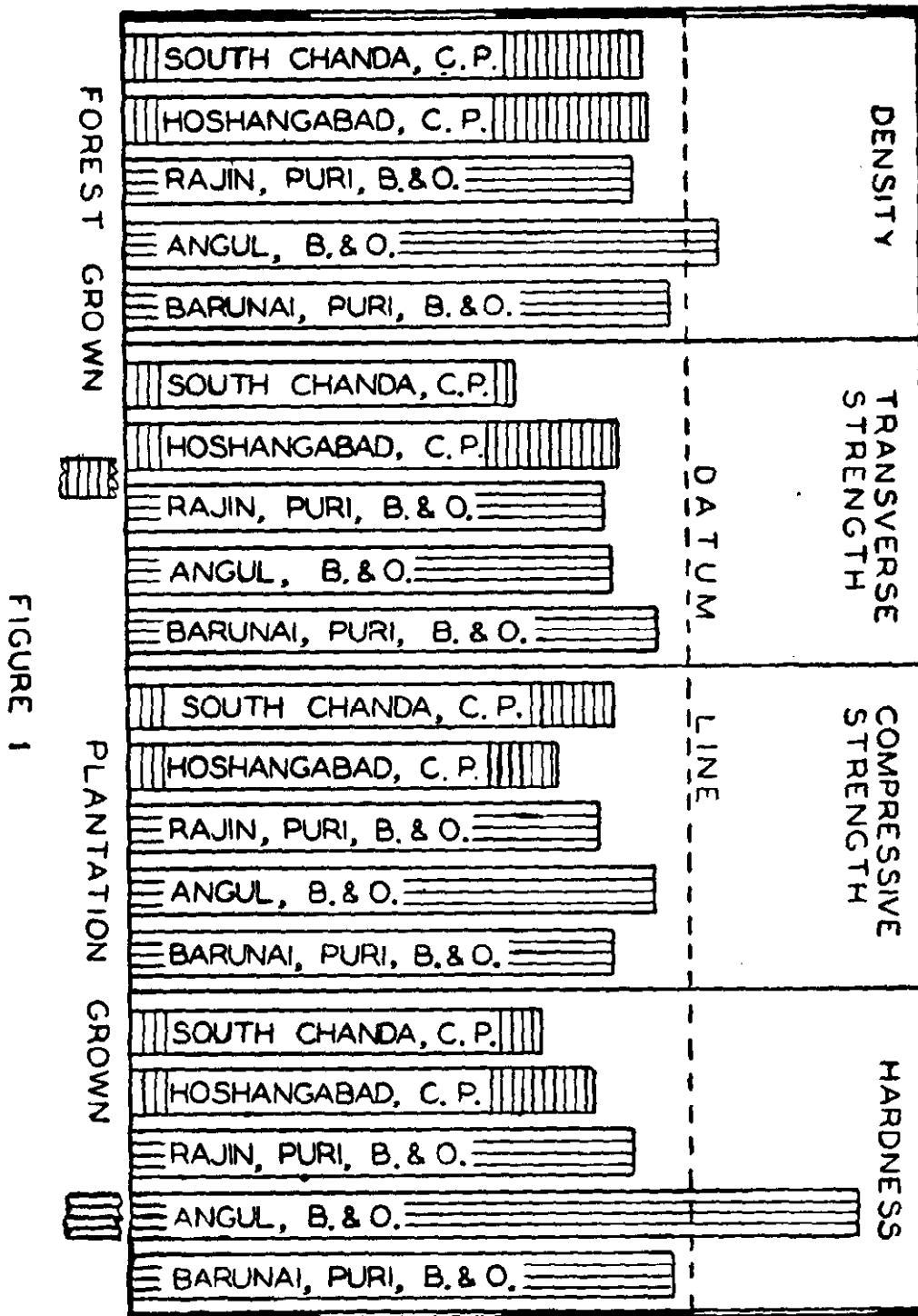
of the test for the coefficient of transverse strain the natural-grown teak has shown itself superior in strength to the artificial product, the strength of the latter is so high that little apprehension need be felt as to its excellent quality." As a matter of fact the data in that Bulletin show the plantation-grown teak to be actually stronger in shear and in compression than the forest-grown teak, and the difference in the case of transverse tests is but slight in spite of the fact that all the variations between the two series of tests were favourable to the forest-grown material.

Again in 1913 the same author published a further note on the same subject in Forest Bulletin No. 14. This Bulletin deals with investigations subsequent to those presented in Bulletin No. 3. In the prosecution of this work advantage was taken of the experience gained in the former research. The work was carefully done to avoid discrepancies either in felling, treatment subsequent to felling, preparation of specimens, or testing. In this case the author's conclusion from the data collected is as follows :—

"The object with which these experiments were carried out was to ascertain whether the plantation-grown teak was as strong as that from natural forests. The answer is without doubt in the affirmative." This conclusion is reached in spite of the fact that there were still some points in the prosecution of the research which had a tendency to favour the natural grown material.

In all the work up to this point the question of growth rate had not arisen and the number of growth layers per inch in the test specimens had not been recorded. This variable has been observed in all the more recent work and the data now available throw an interesting light on the results formerly obtained.

Recent data collected at Dehra Dun show that the average rate of radial growth is faster with plantation-grown than with forest-grown trees. Seven consignments of forest-grown teak trees showed average thickness growths of from 9 to 13 seasonal layers per inch, and four consignments of specimens from plantations varied in their average rate of size increase from 3 to 7 rings



per inch. That the faster growth was accompanied by corresponding higher density and strength values is clearly shown in Figure 1. In this graph a horizontal line marked, "Datum Line," indicates the average properties of Burma and Malabar teak, these being the best known varieties. The lengths of the vertical bars are proportional to the corresponding values for two lots of forest-grown and three lots of plantation-grown teak.

The "datum value" line has no direct bearing on the subject under consideration, as teak from Burma and Malabar has always been found somewhat different from that grown in and about the central portion of India. The chart is intended to furnish a comparison between the forest-grown teak from Hoshangabad and Chanda and the plantation-grown teak of Angul and Puri. Because it was tested green only a consignment of plantation teak grown at Lachiwala, near Dehra Dun, has been omitted from this chart. The Lachiwala plantation teak averaged higher in strength tests in the green condition than any other teak studied at Dehra Dun.

Data are not available for other species grown in plantations. A single sample of *Albizzia procera* received from a plantation in Burma exhibited very rapid growth and high specific gravity, but no general conclusions can be drawn from isolated instances.

The data here discussed are incidental to routine work in Timber Testing. They are not ideal for the study of the effect of growth rate, which should involve the selection of trees grown under various conditions *in the same locality*, and the study of different parts of the same tree which has passed through periods of vigorous and of suppressed growth in its life history. Nevertheless, in spite of their shortcomings, and of the fact that they embrace wide variations of soil, environment and climate, these facts are suggestive and thought to be of sufficient interest to warrant their publication. It must be plain that, if nothing more, they furnish a strong indication that it will probably pay to grow broad leaved trees in plantations as rapidly as is consistent with the production of clear, branchless stems. They suggest that plantation-grown timber of dicotyledonous varieties, if rapidly grown but not over thinned, is good timber.

NEW INDIAN SPECIES OF FOREST IMPORTANCE.

PART 7.

(Continued from the Indian Forester, Vol. L. Nov. 1924,
pp. 573 to 588.)

This, the seventh list of new Indian species of Forest importance described since 1924, is drawn up on the lines of previous ones and enumerates 218 species bringing the total up to 965.

In order to make the list as complete as possible all periodicals in which new Indian species are usually described, and those in which it is thought such might be described, have been consulted and the list has been checked with the seventh supplement of the *Index Kewensis*.

1. **Abies Gamblei**, Hickel, *Coniferae* (Laboratoire Forestier De Toulouse, 1929, Tome ii, Article 1, p. 184), W. Himalaya.
- Acacia diadenia**, Parker, *Leguminosae* (Ind. For., 1929, p. 332), Assam ; Burma.
- A. Meeboldii**, Craib, *Leguminosae* (Kew Bull., 1928, p. 66), Lower Burma.
- Actinodaphne Bourdillonii**, Gamble, *Lauraceae* (l. c., 1925, p. 129), Hills of Travancore, S. India.
5. **A. Bourneae**, Gamble, *Lauraceae* (l. c., p. 128), Pulney Hills, S. India.
- A. Lawsonii**, Gamble, *Lauraceae* (l. c., p. 129), S. E. Wynaad, Nilgiris, S. India.
- A. Tadulingami**, Gamble, *Lauraceae* (l. c., p. 130), Tinnevely dist., S. India.
- Adenosacme Listeri**, King, *Rubiaceae* (Rec. Bot. Surv. Ind., X, p. 298), Himalaya.
- Agapetes Brandisiana**, W. E. Evans, *Vacciniaceae* (Not. Roy. Bot. Gard., Edin., XV, p. 201), Upper Burma.
10. **A. burmanica**, W. E. Evans, *Vacciniaceae* (l. c., p. 199). N. E. Upper Burma.

- A. Unwinii**, W. E. Evans, *Vacciniaceæ* (l. c., p. 205) Burma.
- A. yunnanensis**, Franch., *Vacciniaceæ*, Journ. de Bot., IX (1895), p. 366 (l. c., p. 206), N. E. Upper Burma.
- Alangium Kurzii**, Craib, *Cornaceæ* (Kew Bull., 1929, p. 206), Maliwun, Victoria Point, Burma.
- Alstonia rostrata**, C. E. C. Fischer, *Apocynaceæ* (l. c., p. 315), Thaton, Burma.
15. **Alysicarpus Beddomei**, Schindl., n. com. *Leguminosæ* (Fedde Rep., XXIII, p. 353), Coorg.
- Apama Barberi**, Gamble, *Aristolochiaceæ* (Kew Bull., 1924, p. 386), Tinnevely dist., S. India.
- Ardisia sumatrana**, Miq., *Myrsinaceæ* (l. c., 1928, p. 45), Mergui, Burma.
- Artabotrys siamensis**, Miq., *Anonaceæ* (l. c., 1926, p. 448), S. Tenasserim, Burma.
- Asparagus Fysoni**, Mac. Bride, *Liliaceæ* [Contr. Gray Herb., Harvard Univ. (1918), p. 17], Nilgiri.
20. **Astragalus Isabellæ**, Dunn, *Leguminosæ* (Kew Bull., 1924, p. 384), Kashmir, N. W. India.
- Barleria Gibsonioides**, Blatter, *Acanthaceæ* (Journ. Bom. Nat. Hist. Soc., XXXII, p. 733), W. Ghats of Bombay.
- Barringtonia cymosa**, Fischer, *Myrtaceæ* (Kew Bull., 1927, p. 89), S. Tenasserim, Burma.
- B. Kermodiei**, C. E. C. Fischer, *Myrtaceæ* (l. c., 1929, p. 311), Bassein dist., Burma.
- B. reticulata**, Miq., *Myrtaceæ* (l. c., 1927, p. 209), S. Tenasserim, Burma.
25. **Bauhinia fusifera**, Fischer, *Cæsalpinieæ* (l. c., p. 86), Mandalay dist., Burma.
- B. Helferi**, Craib, *Cæsalpinieæ* (l. c., 1924, p. 92), Tenasserim, Burma.

- B. Parkinsonii**, Fischer, *Casalpinia* (l. c., 1927, p. 87), Mandalay dist., Burma.
- B. sulphurea**, Fischer, *Casalpinia* (l. c., p. 85), S. Tenasserim, Burma.
- Beaumontia (Amalocalyx) rosea**, C. E. C. Fischer, *Apocynaceæ* (l. c., 1929, p. 316), Mergui, Burma.
30. **Beilschmiedia sphaerocarpa**, Lecomte, *Lauraceæ* (l. c., 1928, p. 334), Mergui, Burma.
- Bennettia longipes**, Oliv. in Hook. Ic. Plant., VI, (1887), t. 1596, *Flacourtiaceæ* (Rec. Bot. Surv. Ind., X, p. 238), E. Himalaya.
- Berberis lycioides**, Stapf, *Berberidaceæ* (Curt. Bot. Mag., t. 9102), N. W. Himalaya.
- B. Usteriana**, R. N. Parker, *Berberidaceæ* (Ind. For., 1924, p. 399), Himalaya.
- Brownlowia Meeboldii**, Burret., *Tiliaceæ* (Notizblatt, Bd. IX, p. 615), Tavoy, Burma.
35. **Calophyllum Parkeri**, Fischer, *Guttiferae* (Kew Bull., 1926, p. 455), Tavoy, Burma.
- Campylotropus Drummondii**, Schindl., *Leguminosæ* Fedde, Rep., XI, p. 425), Punjab.
- C. Griffithii**, Schindl., *Leguminosæ* (l. c., p. 343), Bhutan, Himalaya.
- C. Rogersii**, Schindl., *Leguminosæ* (l. c., XXI, p. 21), Tavoy, Burma.
- C. sessilifolia**, Schindl., *Leguminosæ* (l. c., XI, p. 427), Burma.
40. **Capparis subtenera**, Craib et W. W. Sm., *Capparidaceæ* (Not. Roy. Bot. Gard., Edin., IX, 90), Burma.
- Castanola Wallichii**, Schellenb., *Connaraceæ* (Kew Bull., 1929, p. 205), Tavoy, Burma.
- Cinnamomum riparium**, Gamble, *Lauraceæ* (l. c., 1925, p. 128), N. Travancore, S. India.

- C. travancoricum**, Gamble, *Lauraceæ* (l. c., p. 128),
Evergreen forests near Chimanji, Travancore, S. India.
- Clematis Loasacfolia**, DC., *Ranunculaceæ* (Journ-
Linn. Soc., XLVIII, p. 15), E. Bhotan.
45. **C. tortuosa**, Wall. ex. Fischer, *Ranunculaceæ* (Kew
Bull., 1929, p. 4), Sylhet, Khasia Hills, etc.
- Connarus Kingii**, Schellenb., *Connaraceæ* (In Candol-
lea, II, 96 (1925), Andamans.
- C. Planchonianus**, Schellenb., *Connaraceæ* (Kew Bull.
1927, p. 375), Lower Burma.
- Cotoneaster humilis**, Dunn, *Rosaceæ* (Kew Bull.,
1924, p. 384), Kashmir, N. W. India.
- Craibiodendron Henryi**, W. W. Smith, *Ericaceæ*
(l. c., 1928, p. 333), Lahpye Hills of Bhamo dist.,
Burma.
50. **Cryptocarya anamalayana**, Gamble, *Lauraceæ* (l. c.,
1925, p. 126), Anamali Hills, S. India.
- C. Beddomei**, Gamble, *Lauraceæ* (l. c., p. 127), Plains of
Canara, S. India.
- C. Bourdillonii**, Gamble, *Lauraceæ* (l. c., p. 127), Ever-
green Forests of Travancore, S. India.
- C. Lawsonii**, Gamble, *Lauraceæ* (l. c., p. 127), Sholas-
about Avalanche and Sispara, Nilgiris, S. India.
- Cyathocalyx uniflorus**, Fischer, *Anonaceæ* (l. c., 1927,
p. 206), S. Tenasserim, Burma.
55. **Daphne Shillong**, Banerji, *Thymelæaceæ* (l. c., p. 75),
Shillong near Spread Eagles Fall.
- Dendrocalamus Messerii**, Blatter, *Gramineæ* (Ind.
For., 1929, p. 595), Katha dist., Burma.
- Desmodium Lacei**, Schindl., *Leguminosæ* (Fedde,
Rep., XXII, p. 261), Burma.

- D. sikkimmense**, Schindl., *Leguminosæ* (l. c., XXI, p. 6), Sikkim; Nepal.
- D. Toppinii**, Schindl., *Leguminosæ* (l. c., p. 5), Burma.
- 60. Desmogyne angustifolia**, Knagg., *Ericaceæ* (Not., Roy. Bot. Gard., Edin., XIV, p. 73), Headwaters of Irrawaddy, Burma.
- Desmos caudatus**, Fischer, *Anonaceæ* (Kew Bull., 1926, p. 448), S. Tenasserim, Burma.
- Dicerna hispidum**, Schindl., *Leguminosæ* (Fedde, Rep., XX, p. 269), Burma.
- Dimorphocalyx Meeboldii**, Pax. et K. Hoffm., *Euphorbiaceæ* (Das Pflanzenreich, Heft, 85, p. 190), Burma.
- Diospyros Wallichii**, King and Gamble, *Ebenaceæ* (Kew Bull., 1927, p. 92), Mergui, Burma.
- 65. Dipterocarpus angustialatus**, Heim, in Bot. Tids. XXV (1923), 43, *Dipterocarpaceæ* (l. c., 1926, p. 457), S. Tenasserim, Burma.
- D. Dyeri**, Pierre, *Dipterocarpaceæ* (l. c., p. 457), S. Tenasserim, Burma.
- D. Kerrii**, King, *Dipterocarpaceæ* (l. c., 1927, p. 206), S. Tenasserim, Burma.
- Dracontomelum Duperreanum**, Pierre, *Anacardiaceæ* (l. c., 1928, p. 44), Katha dist., Burma.
- Drypetes (Hemicyclia) Kurziana**, C. E. C. Fischer, *Euphorbiaceæ* (l. c., 1926, p. 439), Tharrawaddy dist., Burma.
- 70. Dysoxylum racemosum**, King, *Meliaceæ* (Journ. Asia. Soc., Beng., LXIV, p. 47), Andaman Is.
- D. turbinatum**, King, *Meliaceæ* (Kew Bull., 1927, p. 208), S. Tenasserim, Burma.
- Ecdysanthera multiflora**, King et Gamble, *Apocynaceæ* (l. c., 1928, p. 334), Tavoy, Burma.

- Elaeocarpus Lacei**, Craib, *Elæocarpaceæ* (l. c., 1925, p. 23), Upper Burma.
- E. quadratus**, C. E. C. Fischer, *Eleocarpaceæ* (l. c., p. 429), Burma.
75. **E. tectoniaefolius**, Ridl., *Elæocarpaceæ* (l. c., 1929, p. 205), Mergui, Burma.
- Emblica Fischeri**, Gamble, *Euphorbiaceæ* (l. c., 1925, p. 331), Anamali Hills, S. India.
- Eriobotrya Wardii**, C. E. C. Fischer, *Rosaceæ* (l. c., 1929, p. 205), Namkin Mts., Sheinghku Valley.
- Ficus Angladei**, Fischer, *Moraceæ* (l. c., 1925, p. 332), Lower Palney Hills, Madura, S. India.
- F. smaragdina**, Moore, *Moraceæ* (Journ. Bot., LXIII, p. 171), Tenasserim, Burma.
80. **Gaertnera lasianthoides**, Fischer, *Loganiaceæ* (Kew Bull., 1927, p. 209), S. Tenasserim, Burma.
- G. lushaiensis**, Fischer, *Loganiaceæ* (l. c., 1928, p. 141), Lushai Hills, Assam.
- Garcinia rostrata**, Hussk., *Guttiferæ* (l. c., 1929, p. 205), Mergui, Burma.
- Gigantochloa compressa**, Parker, *Gramineæ* (Ind. For., 1928, p. 97), Burma.
- Gleditschia Delavayi**, Franchet, Pl. Delav. (1890), p. 189, *Leguminosæ* (Rec. Bot. Surv., Ind., X, p. 273), E. Himalaya.
85. **Glochidion Bourdillonii**, Gamble, *Euphorbiaceæ* (Kew Bull., 1925, p. 330), Evergreen Forests of Travancore S. India.
- G. subterblancum**, Fischer, *Euphorbiaceæ* (l. c., 1927, p. 211), S. Tenasserim, Burma.
- Glycosmis Wintii**, Craib, *Rutaceæ* (l. c., 1929, p. 311), Mergui, Tenasserim river, Burma.
- Glyptopetalum quadrangulare**, Prain, *Celastraceæ* (l. c., 1927, p. 311), S. Tenasserim, Burma.

- Goniothalamus latestigma**, Fischer, *Anonaceæ* (l. c., p. 204), S. Tenasserim, Burma.
90. **G. Sawtehii**, Fischer, *Anonaceæ* (l. c., p. 203), S. Tenasserim, Burma.
- Gossypium Bakeri**, Watt., *Malvaceæ* (l. c., 1926, p. 210), Karachi desert, Sindh.
- G. punctatum**, Schet., *Malvaceæ* (l. c., 1927, p. 325), Kashmir ; C.P. etc.
- Greenea Parkinsonii**, Fischer, *Rubiaceæ* (l. c., p. 90), Myitkyina dist., Burma.
- Grewia mesopoda**, Buret., *Tiliaceæ* (Notizblatt, Bd., IX, p. 663), Lachiwala ; Garhwal, Himalaya.
95. **Guioa spathulata**, Fischer, *Sapindaceæ* (l. c., p. 83), S. Tenasserim, Burma.
- Gymnocladus burmanicus**, C. E. Parkinson, *Leguminosæ* (l. c., 1928, p. 333), Taok plateau, Dawna Hills of Tenasserim, L. Burma.
- Gymnostachyum trilobum**, Ridley, *Acanthaceæ* (l. c., 1927, p. 210), S. Tenasserim, Burma.
- Hibiscus flavotrichus**, Fischer, *Malvaceæ* (l. c., 1926, p. 464), S. Tenasserim, Burma.
- H. Parkinsonii**, Fischer, *Malvaceæ* (l. c., p. 463), S. Tenasserim, Burma.
100. **Hopea minutiflora**, Fischer, *Dipterocarpaceæ* (l. c., 1927, p. 207), S. Tenasserim, Burma.
- Hydnocarpus anthelmintica**, Pierre, *Bixaceæ* (l. c., p. 97), Myitkyina dist., N. Burma.
- H. dawnensis**, Parkinson et Fischer, *Bixaceæ* (l. c., 1928, p. 43), Amherst dist., Burma.
- H. verrucosa**, Parkinson et Fischer, *Bixaceæ* (l. c., p. 42), Amherst dist., Burma.
- Illiciium burmanicum**, J. F. Rock, *Magnoliaceæ* (Journ. Arnold. Arbor., VII, p. 238), Burma.

- 105. *Ixora Finlaysoniana***, Wall., *Rubiaceæ* [G. Don, Gen. Syst. III, 571 (1834)], India or.
- Jambosa pseudo-laeta***, Fischer, *Myrtaceæ* (Kew Bull., 1927, p. 312), Tavoy, Burma.
- Jasminum Finlaysonianum***, Wall., *Oleaceæ* [G. Don, Gen. Syst. IV, 60 (1837), India or.
- Justicia alternifolia***, C. B. Clarke, *Acanthaceæ* (Kew, Bull., 1927, p. 206), Lenya Valley, Mergui, Burma.
- Kokoona filiformis***, Fischer, *Celastraceæ* (l. c., p. 311), S. Tenasserim, Burma.
- 110. *Korthalsia Rogersii***, Becc. *Palmæ* (Ann. Roy. Bot. Gard., Calc., XII, ii, 131-132), Andaman Is.
- L. veronicifolia***, Hayek, *Verbenaceæ* (Fedde, Rep., ii, 163), Nilgiri and Kurg.
- Lasianthus longipedunculatus***, Parker, *Rubiaceæ* (Kew Bull., 1925, p. 430), Tavoy, Burma.
- Licuala merguensis***, Becc., *Palmæ* [Becc. in Webbia V, 47 (1921)], Burma.
- Litsea Bourdillonii***, Gamble, *Lauraceæ* (Kew Bull., 1925, p. 131), Travancore Hills in Evergreen Forests, S. India.
- 115. *L. insignis***, Gamble, *Lauraceæ* (l. c., p. 130), Evergreen Forests of Travancore, S. India.
- L. mysorensis***, Gamble, *Lauraceæ* (l. c., p. 130), Bislighat and Aglatti, Mysore, S. India.
- L. robusta***, Bl., *Lauraceæ* (l. c., 1927, p. 314), Katha district, Burma.
- L. travancorica***, Gamble, *Lauraceæ* (l. c., 1925, p. 132), Travancore, S. India.
- Loranthus grandifrons***, King, *Loranthaceæ* (l. c., 1927, p. 317), Mergui, Burma.

- 120. Mahonia calamicaulis**, Spare and Fischer, *Berberidaceæ* (l. c., p. 249), Assam.
- Mangifera Parkinsonii**, Fischer, *Anacardiaceæ* (l. c., 1927, p. 84), S. Tenasserim, Burma.
- Manglietia utilis**, Dandy, *Magnoliaceæ* (l. c., p. 310), Tavoy dist., Burma.
- Melodinus Henryi**, Craib, *Apocynaceæ* (l. c., 1911, p. 411), Amherst, Burma.
- Melodorum Thorellii**, Pierre, *Anonaceæ* (l. c., 1927, p. 206), Mergui, Burma.
- 125. Michelia Baillonii**, Finet. et Gagnep, *Magnoliaceæ* (l. c., p. 310), Katha dist., Bilumyo reserve, Burma.
- M. glabra**, Parmentier, *Magnoliaceæ* [Bull. Sc. France and Belgium, XXVII, 213, 282 (1896)], Assam.
- M. uniflora**, Dandy, *Magnoliaceæ* (Kew Bull., 1927, p. 203), S. Shan States, Burma.
- M. Wardii**, Dandy, *Magnoliaceæ* (l. c., 1929, p. 222), Borders of Tibet and Assam.
- Milusa glandulifera**, Fischer, *Anonaceæ* (l. c., 1926, p. 453), S. Tenasserim, Burma.
- 130. M. saccata**, Fischer, *Anonaceæ* (l. c., p. 452), S. Tenasserim, Burma.
- Mitrephora lophophora**, C. E. C. Fischer, *Anonaceæ* (l. c., 1929, p. 310), Mergui, Burma.
- M. multiovulata**, Fischer, *Anonaceæ* (l. c., 1926, p. 450), S. Tenasserim, Burma.
- M. vulpina**, Fischer, *Anonaceæ* (l. c., p. 449), S. Tenasserim, Burma.
- Mucuna exserta**, C. B. Clarke, M. S. ex. C. E. C. Fischer, *Papilionaceæ* (l. c., 1929, p. 5), Khasia Hills, etc.
- 135. Mussænda Parryorum**, Fischer, *Rubiaceæ* (l. c., 1928, p. 274), Assam.
- M. pentasemia**, Fischer, *Rubiaceæ* (l. c., p. 275), Assam.

- Nannorhops Nandiniana**, Becc., *Palmae* [Becc. in Webbia V. 10 (1921)], India.
- Nannorhops Stocksiana** Becc., *Palmae* (l. c.), Baluchistan.
- Neohouzeaua stricta**, Parker, *Gramineae* (Ind. For., 1928, p. 97), Burma.
140. **Neolitsea Fischeri**, Gamble, *Lauraceae* (Kew Bull., 1925, p. 132), Anamalai Hills, S. India.
- Neopeltandra**, Gamble, n. gen. *Euphorbiaceae* (Gamble's Fl. Mad., p. 1285).
- N. longipes**, Gamble, *Euphorbiaceae* (l. c., p. 1286), Hills of Coimbatore and Anamalai, W. Ghats.
- N. suberosa**, Gamble, *Euphorbiaceae* (l. c., p. 1286), Hills of N. Circars, etc.
- Neotrigonostemon**, Pax. et K. Hoffm., n. gen., *Euphorbiaceae* (Notizblatt, Bd. X, p. 385).
- N. diversifolius**, Pax. et K. Hoffm., *Euphorbiaceae* (l. c., p. 385), Mergui, Burma.
- Nyssa bifida**, Craib, *Cornaceae* (Kew Bull., 1928, p. 333), Misty hollow, Dawna Hills of Tenasserim, Burma.
145. **N. megacarpa**, Parker, *Cornaceae* (Ind. For., 1929, p. 644), Tavoy, Burma.
- Ormosia Watsonii**, Fischer, *Papilionaceae* (Kew Bull., 1927, p. 88), S. Tenasserim, Burma.
- Orophea katschallica**, Kurz, *Anonaceae* (l. c., 1926, p. 455), S. Tenasserim, Burma.
- Oxyrhynchus alienus**, Piper, *Leguminosae* (Journ. Wash. Acad. Soc., 1924, XIV, p. 47), India.
- Pahudia cochinchinensis**, Pierre, *Caesalpinieae* (Kew Bull., 1928, p. 45), Mandalay dist., Burma.
150. **Parkia streptocarpa**, Hance, *Mimosae* (l. c., 1927, p. 209), S. Tenasserim, Burma.
- Pavonia Coxii**, C. Tadulingam and K. Cheriyan Jacob, *Malvaceae* (Journ. Ind. Bot. Soc. V, p. 11), Coimbatore.

- Pellacalyx Parkinsonii**, Fischer, *Rhizophoraceæ* (Kew Bull., 1927, p. 311), S. Tenasserim, Victoria Is., Burma.
- Pentapterygium interdictum**, Hand.-Mzt., *Vacciniaceæ* (Not., Roy. Bot. Gard., Edin., XV, p. 207), Upper Burma.
- Peucedanum Parkinsonii**, Fedde, *Umbelliferae* (Fedde, Rep., XXVII, p. 305), Burma.
155. **Phacellaria malayana**, Ridl., *Santalaceæ* (Kew Bull., 1929, p. 206), Lenya, Mergui, Burma.
- Phyllanthus Narayanswamii**, Gamble, *Euphorbiaceæ* (l. c., 1925, p. 329), Rampa Hills, Godavari, S. India.
- P. Talboti**, L. J. Sedgwick, *Euphorbiaceæ* (Journ. Ind. Bot., II, p. 124), Bombay.
- Piper Barberi**, Gamble, *Piperaceæ* (Kew Bull., 1924, p. 387), Tinnevely dist., S. India.
- N.B.*—Piper spp. C. DC. in Candollea, 1923 and 1925, enumerates and amplifies the descriptions of many Indian species some of which may be of Forest importance.
- Plectronia tavoyana**, Parker, *Rubiaceæ* (l. c., 1925, p. 429), Tavoy, Burma.
160. **Polyalthia crassa**, Parker, *Anonaceæ* (Ind. For., 1929, p. 375), Mergui, Burma.
- P. lateriflora**, King, *Anonaceæ* (Kew Bull., 1929, p. 311), Mergui, Burma.
- Pothos armatus**, C. E. C. Fischer, *Araceæ* (l. c., p. 126), Malabar, S. India.
- Pouzolzia Meeboldii**, W. W. Smith et Ramas. *Urticaceæ* (Gamble's, Fl. Mad., p. 1383), Kavalay in Cochin.
- Pseudoglochidion**, Gamble, gen. nov., *Euphorbiaceæ* (Kew Bull., 1925, p. 329).
- P. anamalayanum**, Gamble, *Euphorbiaceæ* (l. c., p. 330), Anamala, Hills, S. India.
165. **Quercus Kingiana**, Craib, *Fagaceæ* (l. c., 1927, p. 314), Maymyo plateau, Burma.

- Randia uranthera**, C. E. C. Fischer, *Rubiaceæ* (l. c., 1929, p. 314), Tavoy, Burma.
- Reidia Beddomei**, Gamble, *Euphorbiaceæ* (l. c., 1925 p. 331), Chokampatti Hills, Tinnevely, S. India.
- R. Gageana**, *Euphorbiaceæ* (l. c., p. 331), S. Tinnevely, S. India.
- R. gomphocarpa**, Fischer, *Euphorbiaceæ* (l. c., 1927, p. 314), S. Tenasserim, Burma.
170. **R. megacarpa**, Gamble, *Euphorbiaceæ* (l. c., 1925, p. 332), Nilgiri, S. India.
- R. stipulata**, Gamble, *Euphorbiaceæ* (l. c., p. 332), Anamalai Hills, S. India.
- Rhododendron melinanthum**, Balf. f. et Ward, *Ericaceæ* (Tran. & Proc. Bot. Soc., Edin., XXVII, p. 85), E. Upper Burma.
- R. chionanthum**, Tagget., *Ericaceæ* (l. c., XV, p. 309), N. E. Upper Burma.
- Roureopsis stenopetala**, Schellenb., *Connaraceæ* (Kew Bull., 1927, p. 375), Tenasserim, Burma.
175. **Saccopetalum, unguiculatum**, Fischer, *Anonaceæ* (l. c., 1926, p. 454), S. Tenasserim, Burma.
- Sageraea bracteolata**, Parker, *Anonaceæ* (Ind. For., 1929, p. 376), Tavoy evergreen forests, Burma.
- Saurauja subspinoso**, Anth., *Ternstroemiaceæ* (Not., Roy. Bot. Gard., Edin., XV, p. 244), N. E. Upper Burma.
- Schizandra spheanthera**, Rehd. and Wils., *Magnoliaceæ* (Kew Bull., 1929, p. 249), Assam.
- Scleropyrum Ridleyi**, Gamble, *Santalaceæ* (l. c., 1928, p. 334), Mergui, Burma.
180. **Scolopia lucidia**, Wall. ex. Kurz, *Bixineæ* [For. Fl., Brit., Burma, p. 173 (1877)], Tenasserim, Burma.
- Scutellaria teucriffolia**, Dunn, *Labiataæ* (Kew Bull., 1924, p. 386), N. Punjab and W. Kashmir, N. W. India.

- Senecio lushaiensis**, C. E. C. Fischer, *Compositæ* (l.c., 1929, p. 6), Lushai Hills.
- Shorea argentea**, Fischer, *Dipterocarpaceæ* (l.c., 1926, p. 459), S. Tenasserim, Burma.
- S. Buchananii**, Fischer, *Dipterocarpaceæ* (l. c., p. 458), Myitkyina dist., Burma.
185. **S. cinerea**, Fischer, *Dipterocarpaceæ* (l. c., p. 460), S. Tenasserim, Burma.
- S. farinosa**, Fischer, *Dipterocarpaceæ* (l. c., p. 461), S. Tenasserim, Burma.
- S. sericeiflora**, Fischer et Hutch., *Dipterocarpaceæ* (l. c., p. 433), Pegu Circle, Burma.
- Sloanea Kerrii**, Craib, *Elaeocarpaceæ* (l. c., p. 466), Tavoy, Burma.
- Smilax erecta**, Osmaston, *Liliaceæ* (l. c., 1925, p. 284), Garhwal.
190. **Sorbus Wenzigiana** (Schneid.), Koehne, *Rosaceæ* (Fedde, Rep., X, p. 516), Kumaon.
- Sphaerocoryne Blandfordiana**, Fischer, *Anonaceæ* (Kew Bull., 1926, p. 451), S. Tenasserim, Burma.
- Sphenodesme mollis**, Craib, *Verbenaceæ* (l. c., 1928, p. 45), Tavoy, Burma.
- Sphinctacanthus Parkinsonii**, Fischer, *Acanthaceæ* (l. c., 1927, p. 210), Myitkyina dist., Burma.
- Spiraea affinis**, Parker, *Rosaceæ* (Ind. For., 1930, p. 107), Kangan Valley, Hazara, Kashmir.
195. **S. Duthieana**, Zinserling, *Rosaceæ* [Not., Syst. Herb. Hort. Petrop. V. 64 (1924)], Kumaon.
- S. hazarica**, Parker, *Rosaceæ* (Ind. For., 1930, p. 107), Kangan Valley, Hazara, Kashmir.
- S. lycioides**, Parker, *Rosaceæ* (l. c., p. 106), Kashmir.
- Stephania gracilentia**, Miers, *Menispermaceæ* (l. c., 1924, p. 398), Nepal.

- Strobilanthes Parryorum**, Fischer, *Acanthaceæ* (Kew Bull., 1928, p. 142), Lushai Hills, Assam.
- 200. Symplocos subsecunda**, Brand *Styracaceæ* (Fedde, Rept., XIV, p. 326), Nepal.
- Tetrastigma subsuberosum**, Planch., *Ampelidaceæ* (Kew Bull., 1929, p. 205), Pawut, Mergui, Burma.
- Tragia Muelleriana**, Pax. et Hoffm., *Euphorbiaceæ* (Das Pflanzenreich, Heft 68, p. 80), Highland of Malabar coast.
- Turraea pumila**, Benn., *Meliaceæ* (Kew Bull., 1926, p. 468), Maymyo plateau, Burma.
- Uraria Henryi**, Schindl., *Leguminosæ* (Fedde, Rep., XXI, p. 15), Burma.
- 205. U. Kurzii**, Schindl., *Leguminosæ* (l. c., p. 15), Lower Burma.
- Vaccinum densum**, Miq. ex Schank, *Vacciniaceæ* [Zittel. Handl. Palaeontol. II, 719, fig. 375, (1890)], Mont. Nilgiri.
- Vallaris arborea**, Fischer, *Apocynaceæ* (Kew Bull., 1927, p. 92), S. Tenasserim, Burma.
- Vateria macrocarpa**, B. L. Gupta, *Dipterocarpaceæ* (Ind. For., 1929, p. 231), Madras.
- Vatica astrotricha**, Hance in Journ. Bot. 1876, 241 *Dipterocarpaceæ* (Kew Bull., 1926, p. 457), S. Tenasserim, Burma.
- 210. Vernonia hyalina**, Fischer, *Compositæ* (l. c., 1927, p. 91), Maymyo, One Tree Hill, Burma.
- V. membranacea**, Bedd., *Compositæ* (Journ. Bot., LXIII, p. 170), Nilgiri, S. India.
- V. Parryæ**, C. E. C. Fischer, *Compositæ* (Kew Bull., 1929, p. 6), Lushai Hills.
- V. recurva**, Bedd. *Compositæ* (Journ. Bot., LXIII, p. 171), Anamalai Hills, S. India.
- V. tavoyana**, Fischer, *Compositæ* (Kew Bull., 1927, p. 92), Tavoy, Burma.

215. *Viscum mysorense*, Gamble, *Loxanthaceæ* (l. c., 1925 p. 329), Mysore, S. India.

Vitis Jacquemontii, R. N. Parker, *Ampelidaceæ* (For. Fl. Punj., ed. 2, p. 559), Himalaya and Sub-Himalayan tract.

Walsura gauca, Fischer, *Meliaceæ* (Kew Bull., 1927 p. 82), S. Tenasserim, Burma.

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Forest Research Institute,

DEHRA DUN

14th August 1930.

C. E. PARKINSON,

Offg. Forest Botanist
and

MUKAT BEHARI RAIZADA.

FOREST AND STREAM FLOW.

BY E. BENSKIN, I.F.S.

The usual explanation of forestry text books of the effects of forests on the retention of rainfall is that forests by means of the litter soak up the rainfall very much in the same way as blotting paper dries ink. This theory is entirely wrong, at least so far as Chota Nagpur plateau is concerned. I have for some years been especially interested in the effects of forests on stream flow and am perfectly satisfied from many examples that forests have a very marked effect on the run-off of water and perhaps to a greater extent than they do in more temperate countries.

The amount of leaf litter which annually falls in the case of first quality sal forests is capable of absorbing slightly less than 0.03" of rain, this is the moisture-holding capacity. Its effect on the retention of rainfall is therefore negligible. In what way do forests then affect the run-off of water? I have recently been ascertaining the moisture contents of soils under forests and in the case of denuded lands and find that the moisture content at the end of the hot weather, prior to the monsoon, was actually higher in the case of the denuded land than in the case of the forests. In both

cases soils of identical physical characteristics were taken, except that in the case of the denuded land approximately 9" of the 'A' horizon had been lost through sheet erosion, probably during the last 50 years. The following table gives the necessary details:—

AFFORESTED—SAL HIGH FOREST.			DENUDED LAND.		
Depth.	Description of soil.	Moisture content.	Depth.	Description of soil.	Moisture content.
0"—9"	Light brown red silt.	0.42%	0"—9"	Brown red silt ...	0.66%
9"—18"	Brown red silt ...	0.65%	9"—18"	Do. ...	0.82%
18"—27"	Do. ...	0.80%	18"—27"	Do. ...	1.00%

NOTE.—Both areas were open to grazing of equal intensity. In the case of the forest, the crop consisted of old IV quality stock, of normal density, and without undergrowth. The denuded land was almost entirely bared of vegetation through overgrazing.

Very similar figures were obtained by Simpson of America whose investigations showed that the average moisture content of soil covered with timber is much less during the growing season, down to a depth of 3 ft., than of similar soils denuded of all vegetation.

Apart from the effects of canopy on actually preventing rainfall reaching the ground, the main effect of forests or other vegetation on stream flow is through the transpiration of moisture from the soil by the forests. The forests by means of their leaves and roots act very much like a pump in depleting the moisture to a greater extent than in the case of denuded soil. Further the surface soil of the forests is not replenished by the upward capillary movement of water to the same extent as in the case of the denuded land. The result is that the forest soil is capable of absorbing a greater amount of water which is continually being reduced by transpiration throughout the year. It is very notable in Chota Nagpur and Western Bengal how water lies about without sinking in, or runs off the surface of denuded

land, causing the serious floods and havoc in this part of India : this is specially noticeable after a break in the rains and is probably the result of the opposing capillary and gravitational forces.

The transpiration coefficients of grasses are far higher than in the case of forests. Briggs and Shants, working at Beshantchuk Samara, Russia, show that grasses have a transpiration coefficient of 861, this being the weight of water transpired during the production of a unit weight of dry matter. This doubtless explains the very great influence of grass on the run-off of water and prevention of erosion. Probably the system of grazing, which results in wide areas being bared of vegetation almost throughout the entire year in India, has more to do with floods and erosion than any other influence.

THE RELATION BETWEEN SAL FORESTS AND FIRE

By A. J. W. MILROY, I.F.S.

This Circular issued to Range Officers in the Sal Divisions in Assam, explains in an entirely elementary way how the present method of treatment came to be adopted and how it should be carried out.

We know from old records and local tradition that most of the Sal Reserves in the Plains of Assam and in the Bengal Duars originated from fire-swept grassy tracts containing clumps of sal, such as may be seen to this day in the Zemindari forests visible from the train in Goalpara, and along the South Trunk Road in Kamrup and Goalpara.

The generally well-grown state of our Reserves is the direct result of fire protection but, while this has favoured the establishment of fine woods, it has effectively prevented them from reproducing themselves naturally by having encouraged a ground-covering of evergreen undergrowth, which keeps the soil moist shaded and soggy during a great part of the year, an environment that is fatal to the well-being of seedlings.

Efforts extending over many years having failed to obtain natural regeneration in the Reserves, it came to be recognized

that the only hope of achieving this in our part of the world would be by having recourse to Nature's own method, that is to say, by returning to the original condition of open grassy forests, though without, of course, reproducing the undesirable features of scorched stems and large blanks so commonly found in the neglected Zemindari forests. Reasonable thinning out of the over-head canopy combined with the felling of undesirable species and the cutting and subsequent burning of the undergrowth are the measures which, we find, produce the desired conditions. The effect of fire is cumulative and, if the cutting and burning of the undergrowth is persisted in for several years over the same small area, it will be found that the fires soon begin to spread over an increasingly wide portion of the surrounding forest.

It has also been our experience that the combined effect of thinning and burning is to encourage eventual invasion by thatch, even when no thatch is known to be growing anywhere nearby whence seed can be expected to be brought by the wind; from this it may be concluded that the thatch seed is so light that it is carried great distances through the air.

We do not yet know exactly why sal natural regeneration should be so profuse on grassy land that is regularly burnt, but it is clear that for some reason the surface conditions are exactly what suit it best; given these conditions seedlings will establish themselves even on sites where owing to a high water-table or other adverse circumstances, there can be no hope of raising anything better than a crop of inferior III class trees.

This grassy state so favourable for regeneration may, however, be most inimical to the growing stock owing to injury resulting from the annual fires, and for this reason it is very necessary to apply early burning wherever sal is standing over thatch which will burn fiercely when dry.

Early burning is not a matter of dates so much as of the ripeness of the grass, and no burning can be classed as "early," whatever the date may be, if the grass is so dry that the fire, once kindled, runs through it without further trouble such a fire would certainly be of considerable intensity.

Early burning is achieved at the time, generally in December or January, when the tops of the grass are still so green that fire can only be compelled to burn by being constantly lighted and re-lighted. There is always an accumulation of dry sheaths and so on round the stems of the grass, and these can be made to burn in a half-hearted manner by thrusting in torches made of wisps of thatch.

There is not much more to be seen at the time than a sort of general scorched appearance, but the effect is magical, for the green tops soon shrivel up and the dead grass falls to the ground, where it rapidly disintegrates, so that by the time the leaf-fires start there is very little material left which can blaze up dangerously.

If early burning is being undertaken at the right time, operations are best carried out during the middle of the day after the dew has dried up, as every assistance is required to induce some sort of a fire to pass through, but if on the contrary the thatch is already fairly dry, the firing should be done while the heavy dew is still on the grass and likely to discourage anything of the nature of a roaring fire.

Late, as opposed to early, burning is indicated in compartments containing little grass but much heavy evergreen undergrowth; this must be cut and allowed to dry before fire is set, preferably on a hot, windy day when the debris will burn thoroughly, and the fire, or at any rate its scorching effect, will spread into the surrounding damp jungle.

Intermediate conditions, where there is neither much thatch nor heavy evergreen undergrowth, are met by burning the forest when it is reasonably dry on calm days, in the absence of any high wind which might allow the fires to get out of control.

There appears to be some unanimity amongst forest subordinates that a great deal of unnecessary fuss is made about early burning, seeing that the thatch will burn without any trouble if left for another 3 or 4 weeks and, if ignited in the absence of wind, without (visible) damage to the growing stock.

It is impossible, however, to suppose that a grass fire of even only moderate intensity can run through a forest without either causing some loss or doing some harm; at the best increment growth is likely to be checked, though this requires proof; at the worst individual stems are weakened and become subject to insect attack. The mere fact that the trees put out their new leaves in the ordinary course of events after a fire cannot be accepted as a proof that no damage has been done.

The cycle of events in the history of a compartment in a sal forest managed in conjunction with fire will be much as follows:—

(a) *Periodic Block I.*—The overhead canopy will be lightened by thinnings and the evergreen undergrowth cut and burnt in order to encourage grass to come in. The compartment will be burnt as late as possible to start with in order to allow the scanty inflammable material to burn thoroughly, but as the amount of thatch increases the burnings will be started earlier and earlier until the time arrives when fierce fire can be apprehended and real early burning has to be resorted to.

After the removal of the last of the standing trees a good, late, raging blaze will be advisable in order to burn all saplings and advance growth down to ground-level so that new clean shoots may spring up.

The last operation, if labour suffices, might well be the cutting back of such advance growth as has been damaged by fires but not killed down to the ground. The compartment will then pass into:—

(b) *Periodic Block V.*—Complete fire-protection must be enforced until the young trees begin to thin out the grass, when early burning can be commenced in order to save the cost of further fire-protection. If it was not found possible to run through the compartment with the knife before commencing fire protection, the fire-damaged saplings must all be removed during the first cleaning.

The importance of ensuring complete protection from fire in Periodic Block V cannot be exaggerated, but here again, because the young poles throw out new leading shoots and no

damage is visible after a couple of years, Range Officers are only too prone to report that all is well.

Provided that fires only occur after every 2 or 3 years a crop of sal can be raised that is quite pleasing to the eye, but it is not honest forestry because unsoundness will have been caused and will become apparent as the poles increase in age.

Honest forestry demands that we should hand on to our successors a clean-grown, sound forest, if this can be achieved by care and effort.

Our compartment now passes into:—

(c) *The Intermediate Periodic Blocks.*—The Forest Officer will be tempted, having turned the evergreen undergrowth into thatch at the cost of so much trouble to maintain the compartment fairly open above with a light growth of thatch on the ground, a state of affairs that can be easily perpetuated by means of annual burning, but it is doubtful if this would be good silviculture, for it is clear that fire-protection presents the optimum conditions for tree-growth, because the soil remains rich in the humus which goes to feed the trees. The ideal would be for a fire to run through the forest every 4 or 5 years, just sufficient to prevent a return to the condition of a very heavy evergreen undergrowth, but as Nature can hardly be expected to oblige in this convenient fashion, it will probably be necessary to fire-protect large blocks of forests for a number of successive years, and then to let them burn or not as chance may direct, while other areas are being protected. Once grass has gained a foothold the presumption is that a forest, if left to itself, is more likely to suffer from fire than to revert to the damp state, but, if it happened that a period of fire-protection was followed by a succession of wet years, it might be necessary to compel fires to run through certain areas in the Intermediate Periodic Blocks to save them from proceeding too far towards the evergreen condition.

The Forest Officer, in fact, will be faced with the interesting problem of preserving the balance between the over and the under-burnt condition, but he will have the satisfaction of knowing

that, even if a fire did sweep through a protected area, there would be nothing to wring his hands about and that, if early rains did upset his burning programme, there would be no reason to fear an immediate return to the undesirable conditions from which so much of our Periodic Block I has started.

There remains one thing to be said in connection with fire and that is that woods, which have sprung up in long-burnt grassy land, do not suffer from creepers or oppression by undesirable species until the pole stage is approaching, so inimical have been the fires to everything except the thatch, the sal and certain fire-resistant species. Sal plantations, on the other hand, seem never to be free from creepers, and cultural operations must be undertaken every 3 or 4 years in order that the creepers may be kept in check. It would appear from this that it may become necessary to burn our sal plantations annually in order to kill out the creepers and weeds so that we may be saved from the great expense of continual cultural operations, although, of course, it is improbable that the immunity from creepers will be as great in areas burnt over for a few successive years, while Periodic Block I is being converted into Periodic Block V, as it is in the grass lands, which have been burnt annually for so very many years.

CAPTURING OF ELEPHANTS IN TRAVANCORE

BY S. G. M. ANSELM.

The article of Mr. R. S. Browne on the "Capture and training of elephants by the Madras Forest Department in South Malabar," in the June number of the *Indian Forester*, has prompted me to write the following particulars of the operations as carried on in the neighbouring South Indian State of Travancore whose forests possess a large number of elephants and where their capture and training form a regular item of forest work annually, yielding a revenue of a quarter of a lakh of rupees to the State. The information given here is intended only to supplement what was stated by Mr. Browne, as the method described by him is practically what is in vogue here.

The season for capturing begins in December and ends in May. At this time of the year there being very little rain, the herds migrate from one locality to another in search of water along well-beaten tracks; and a strong easterly wind drives them in panic now and then in their march, to be but all the more easily caught in the pits laid out for them on the way.

The pits are located in groups of two or three on frequented tracks: when three they are echeloned. Sometimes three or more pits are dug in a line where a track deploys into level ground. The arrangement of pits thus depends on the terrain. For economy of cost circular pits are dug, with a diameter of 12 feet at top and 9 feet at bottom and a depth of 12 feet. Such a pit costs Rs. 12. Not more than 3 feet of space is ordinarily allowed between pits in a group to ensure easy falls, with the result that not infrequently a morning's visit to the pits by the pit-watchers would reveal more than one animal trapped in a group of pits. This spacing would be too dangerously narrow for the square pits of South Malabar, unless arranged diagonally.

From the pitfalls only animals of 3 to 7 feet height at the withers are captured as a rule. Sucklings and very old elephants are liberated, the former owing to their susceptibility to sicken and die from change of diet and the latter on account of their intractability. When an old elephant is released from a pit, care is taken to let him get out on the side nearest the track so that he may be easily scared away. Neglect of this point caused a forest subordinate, two years ago, to be all but trampled to death by an elephant which on coming out of the pit and not immediately finding his way, veered round and charged the crowd on the opposite side.

As soon as an elephant that has fallen into a pit is found fit for capture, he is noosed with three ropes made of the fibre of *Sterculia villosa* bark, two at the neck and one at one of the hind legs, in the manner described by Mr. Browne. For very small animals the neck ropes alone may suffice. Having noosed one rope round the neck, the second noose for the neck can be slipped down without much difficulty by passing the first rope

through it and working it down the elephant's head with forked or hooked sticks.

Once the nooses are secured, the pit is filled up with billets and brushwood particularly on the side where the capture is desired to climb up, for convenience for the decoys to manœuvre. After the captive comes out of the pit and has spent itself in struggling to get away, the ends of the ropes which are tied to trees during this time, are slowly untied and held by men, while two decoys close up on either side and grip the neck ropes. The leg rope is generally held by men alone, so that it is seldom that a third decoy will be required for elephant-capturing operations in a centre. While the captive is marched off to the kraal, the ends of the ropes are not tied round the bodies of the decoys, as is done in South Malabar, for fear of hampering them in any way in case a captive should turn out to be too bellicose, but held by men and wound round trees on the way whenever the decoys' grip is let off. On the captive being enkraaled, the ropes are cut away by holding the animal to one side of the kraal.

The wounds sustained in the pit, during the march, and for the first few days in the kraal, are washed morning and evening by jets of water syringed on them, which is very effectively done by means of a solo sprayer. A little time after the washing, when the water on the wounds has dried, carbolic oil diluted in eight parts of cocoanut oil is applied to them. A very effective treatment for rope-galls and other deep abrasions is to apply the powdered bark of *Carallia lucida*. If the captive shows any signs of internal disorder, he is better put into the hands of an elephant *vydhian* (doctor) for treatment (as some of them are clever men in their profession in Travancore), than a veterinary surgeon who has very often to learn by experimenting on the animal to its detriment.

FORESTRY RESEARCH AND INDUSTRY.

Mr. W. A. Robertson, Conservator of Forests, Utilisation Circle, Burma, gave an address at the Rangoon Rotary Club on "Forest Products Research and its Relation to Industry" on the 8th July, 1930.

Mr. Robertson said,—

"Before I proceed with the subject of this address I must warn you that although I have been connected with research for a number of years I am not a real "dyed in the wool" research worker. I ought properly to bracket myself with the art-critics, those unfortunates who know all about their subject but can do nothing.

My object to-day is to put before you some aspects of our work in Burma and elsewhere which have direct bearing on industry and to indicate the collaboration with and by industry which is wanted to give the country the best value for the money they spend on forest research. It has often struck me that in industry the research worker and his job is looked on with some of the suspicion that hung over the old alchemist and his work. Something of the stuffy atmosphere of stale herbs, dried toads and stuffed alligator is supposed to hang round him, his work and his laboratory. Where in old days men only went to the alchemist when they had a real bad pain inside or wanted to push a difficult rival off his perch, so some industries to-day still seem rather shy of research. Happily this attitude is steadily disappearing, but I think that many of those engaged in commerce and industry fail to realise that research and more particularly forest products research badly wants industry and commerce to show them definite objects upon which work can be directed.

Forest products research work started in India in 1909 but it was not until well on in the war that the "alchemist" attitude I have referred to was dispelled and in about 1920 it was realised that one centre in India could not deal with the whole area of the Indian Empire and local centres in various provinces were started, Burma being one of the first.

GOOD DEAL OF UNCERTAINTY.

At the beginning there was a good deal of uncertainty as to what objective to make for and unfortunately industry could not give us much of a lead. Trade in forest products was confined to a very small number of species and the big slump following the war naturally damped down any ardour for opening out new lines.

At that time foresters and the few others interested in such matters believed that Burma would be in the future one of the world's big reserve supplies of timber and accordingly investigations were started to see how an export trade of timber other than teak could be started to get into touch with industry in Europe.

In the first place we had to find out what our timbers were really useful for. Outside of teak we knew the rough properties of about four or five species of trees and there remained several hundred others about which we knew next to nothing. Spotting a winner at Kyaikasan was child's play compared with spotting a timber likely to be a winner in an export market.

At the same time we had to make ourselves sure that we could supply the particular timber we proposed to, in other words we must be in a position to identify our timbers. That alone meant months of careful collecting of specimens and of botanical identifications, and now after seven years we have a reference collection of over 800 specimens which will stand comparison with any in the world for accuracy of identification and it is in constant use. Messrs. Steel Bros. can tell you whether it has been of any use to industry or not.

While this collection was going on we started in to try out some timbers which we could identify with tolerable certainty and in the course of about 4 years we had worked on nearly a hundred species. Their selection was what I may call scientific guess-work, sometimes we went on appearance, sometimes on botanical relationship, at others on local uses and I think we can take a certain amount of pride in the fact that the number of real "duds" was very small while in the end we got down to about 40 species of real utility in various directions.

NO HUGE SUPPLIES.

While the prospects of building up an export trade proved to be very much less cheerful than we expected, our investigations brought in a lot of useful information. One important fact came to light namely that Burma does not contain anything like the huge supplies of timber it was supposed to and that the indications are that not so very far off in the future the country will

need all the sustained yield of timber it is likely to produce. Burma's export trade of timber will not be the disposal of a huge surplus of timber to help shortages in other countries but an exchange export through which the hardwoods of Burma will help to balance the softwoods, etc., which the country's industries need and cannot obtain locally.

This gives a new orientation to our research, for this reason Burma's present recorded consumption of over 500,000 tons per annum of timber other than teak and nearly a million tons of fuel is confined to a very small number of species. The final sustained yield will consist of several hundred species, good, bad, and indifferent and we shall probably be generous if we put it at 750,000 tons of timber per annum other than teak, leaving fuel out of account. Instead of pulling the plums out of the bun and leaving the dough Burma will have to eat the whole bun, dough and all. To continue the metaphor, the job in front of forest products research is to make the dough tasty and nutritious.

It will not be a spectacular job by any means and there will be many failures before any success is achieved. Some people may well ask "why carry out this research at all, why not let matters sort themselves out and adjust themselves to the altering conditions?" The answer is that such a method is wasteful and the most expensive in the long run. The true economy is to utilise as intensively as possible all the material available and to do so foresters in Burma need to have information ready in anticipation of the demand.

This very big problem cannot be solved by the research worker single handed. It requires the co-operation and collaboration of the most advanced parts of the community and one naturally looks for them in commerce and industry. How can they collaborate with the research worker? First by putting their problem before him, because even if he has no help to give the enquirers at once he gets an idea of where to direct his work. The clearer the problem is stated the easier it is to tackle. That seems a very obvious point but I can assure you that many people overlook it. I remember for instance a worthy who wrote to me

asking for a forest product which would kill worms. He did not say what worms. To save time I sent him a list of about twenty different sorts of worms starting with earthworms and finishing with glowworms and asked him to strike out those he wasn't interested in. I fear he thought me flippant but in the end he did tell me fairly exactly what he wanted.

NEW IDEAS OFTEN TURNED DOWN.

Next to give the research workers' suggestions and materials a fair honest trial under industrial conditions. Prejudice against new materials or methods is very natural and is very common in the humbler walks of industry. New ideas are very often turned down out of hand by foreman or workmen because they do not fit in exactly with current practice and they will not get an honest trial unless pressure is applied from the higher ranks. In this connection it is well to remember that among natural products such as timber, fibres, oils and gums it is extremely rare to find one product which is an exact substitute for another. If such a substitute existed you may be sure it would already be in use; so that to make use of a substitute some change in current practice is inevitable.

Lastly and most important of all to tell the research worker the result of the trial given to his ideas or materials. It is astonishing how few enquirers ever tell the research worker whether the results are good or bad. He is usually left to find out by indirect means, he notices that there is an increased demand for a product or that some piece of apparatus has been installed. He is left in the position of a man at long range target shooting with no one scoring at the target. He doesn't know whether he is getting bulls or is off the target altogether.

Sometimes this lack of information is due to the enquirer not wanting to hurt the feelings of the research worker by telling him that the results are no earthly good. There is no need for such consideration. *Every research worker is quite ready to hear that the suggestions are no use whatever but he does want to know why there has been a failure.* That corrects his aim. Also he likes to hear of success and its details because that gives him a line to try for further improvements.

I have heard it said that an industrialist likes to keep successes to himself for fear that a rival might benefit by the knowledge. In the case of private research such an attitude is natural and reasonable but it is hardly fair where the research is carried out at public expense. The tax-payer at large is entitled to expect that those who benefit from public expenditure should make some return for it and collaboration with research seems the most obvious return.

We ask industry to signal our shots to us. If we are on the target we ask them to put up a spotting disc for us and if we have missed we want to know whether we are high or low, have just shaved the target or gone clean over the stop-butt.

Now it is industry's turn to ask what we can do for it. First, all our available information, which is not confidential is at their disposal free. True it may not be much but if we haven't got it we try to get it. Next as to materials, our policy is to supply, wherever possible, a free sample for the enquirer to test under his own conditions. We supply the raw material or make it up as he prefers. Then if he comes back and asks for more we supply it at what is practically cost price and try to keep him supplied until he has had time to arrange for his own supplies through the ordinary channels of trade. Finally our organisation, imperfect as it admittedly is, is available for making identifications, working out specifications and passing timber. These latter activities are not what one would ordinarily call research but here in Burma they are.

So little is known of most of our products, how much can be got and of what quality, that to gather information on these points takes as much or even more work than to find out their strength or other proprieties. The latter concern the technician more than the trader.

I have tried to avoid boring you with figures and names of trees which convey so little outside a technical discussion but I hope I have been able to indicate what a great opportunity there is for industry and commerce to combine with research in developing the forest resources of Burma."

**NOTES ON GERMINATION AND SOWING OF BONSUM
(PHOEBE HAINESIANA) SEEDS UNDER SHELTER-
WOOD AND TAUNGYA.**

BY A. K. ADHIKARI, P.F.S.

1. The fruits are generally ripe by the end of October, and begin to fall from the beginning of November or some times earlier, and by the end of the month they are all on the ground. Collection of seeds may be begun by the middle of December. By that time the succulent pericarp rots or dries up and the seeds can be easily examined and collected in quantity. The time for ripening varies in different districts and to some extent within the district if there is marked difference in the rainfall. The remarks here are confined to Nowgong of Upper Assam. Select a few good seed-bearing trees and clear the ground all round. It is better to select trees on the river bank subject to flooding as the seeds falling on the sand deposit are better preserved than on the damp soil. The fruits are rarely eaten by birds or any other animal and the only enemy is the jungle fowl and porcupine which eat the fleshy cotyledons of the germinating seeds, proving at times a regular danger to the plantation. As to the collection, it is better if it is done on contract. The hill tribes living in the vicinity will soon take to it if they are paid ready money, but before they are paid the seeds should be examined as the quantity can easily be made up of bad seeds, generally insect eaten or light immature seeds. The seeds are egg shaped, about $\frac{1}{2}$ " long and $\frac{1}{4}$ " round, with an outer cover of a membranous testa and are generally heavy. When a handful of seed is taken, it can easily be said if they are good or bad by the weight and the look. Store the seeds in a dry cool place spreading them out in layers and covering them with a thin layer of sand. The seeds are not to be shaken in bags and unnecessary handlings must be avoided as they are very liable to split.

2. At first we raised seedlings in nurseries, but we now find that they do quite well by direct sowing, and once sown and covered with a $\frac{1}{2}$ " of soil, the seed will keep quite well and the germination will be nearly cent per cent. Contrary to the current

belief, we also find that the seeds keep; thus seeds collected in December and sown as late as March resulted in 60% germination. The seedlings need protection from the heat of the sun. It has been observed that fresh shoots are thrown out by a few of the plants after the first ones have been killed. The germination both in a nursery and in lines under shelter-wood is extraordinarily good. The March showers bring about 60% germination and the rest wait till the break of monsoon and continue till the end of July. For the first 3 or 4 years of its life it distinctly wants overhead shade. To reproduce the species artificially, it is necessary to find out what are the factors which are responsible for the poor natural regeneration in the forests. If these conditions are overcome success in plantation is assured. The germination under the natural condition in the forests is as prolific as it is in the nursery but with the coming of the monsoon rains the excessive heavy shade and the weed growth swamps the seedlings and death is caused by damping. The first thing to be done is to get rid of these factors, so the area to be sown should be treated beforehand.

A potential *bonsum* area being selected for plantation, climbers should be cut all over the area. I may mention here that the failure of natural regeneration of many of the evergreen species is directly due to excessive climber growth. It not only reduces the seed producing capacity, but it shuts out the sunlight altogether, and this during the rains stops all evaporation causing the soil to become excessively moist. Then comes the removal of all saplings and pole growth of subsidiary species of the thickness of a man's wrist and also all crooked and unsightly poles. This thinning and cleaning of the undergrowth does not require a trained man and all that is necessary is to send a forest guard to go over the area automatically following the prescription; but this alone will not improve the light condition. In places special thinning will have to be done to rectify the heavily shaded area and for this a trained man is necessary, as over doing it will mean the invasion of *Eupatorium* and the under-doing of it retards the growth of the seedlings. That subsequent removals should be reduced to a minimum should be the object; but nevertheless cutting out a tree here and there will have to be

done in future to make small openings in the canopy of the shelter-wood.

The great characteristic of this species is that it can push its head through incredibly small openings hence the thinning, if done judiciously, can reduce the cost of weeding and subsequent operation to a minimum. There will be a few tall trees left forming the upper-most canopy. This does no harm. Besides the area selected being often the worked-out one, these will be always very few. Lines may then be laid out at intervals of 12'. Soil may be hoed all along the line—if continuous sowing is contemplated—but if done in "thullies" hoeing in patches 2½' apart will do. Four or five seeds put out at interval of 1' all along the lines will give masses of seedlings. Sowing in "thullies" gives as good a result as line sowing. It is less costly and is therefore preferred. All these may be done in January when labour is easily available. Climber cutting if done a year ahead is better, as it gives a better idea of the light condition at the time of thinning.

3. Sowing in *Taungya*:—*Boga medeloa* (*Tephrosia candida*) is to be grown first in lines at intervals of 12' to 14' giving space for *dhan* (paddy) to grow. *Bonsum* seeds are to be sown by the side of it, but not midway between the lines as in the case of *sal*. As a rule many of the evergreen species seem to do very well when they are grown by the side of *boga medeloa*. It affords them the protection they need against the hot sun and the soil moisture is retained. If *boga medeloa* is grown a year ahead it will be possible to sow *bonsum* in January as in shelter-wood. But if this cannot be done *i.e.*, if *boga medeloa* and *bonsum* are to be sown the same year, the sowing of *bonsum* should be deferred till the break of the monsoon and the *boga medeloa* should be sown a month ahead of it. The latter will grow sufficiently big by the time *bonsum* seeds germinate and will be able to provide the light shade the seedlings need during the rains. In *taungya* the seeds are to be sown a little deeper, as the erosion of the top soil often causes extensive damage in case there is a heavy shower following the sowing. The seeds are fairly heavy and they are generally rolled down with the help of rain into the valley, that is why often patches of *bonsum* are found far away from the mother trees,

but otherwise the distribution is mostly confined to and round the mother trees. So far as the growth is concerned the *taungya* method is not bad, but it is costly if it is to be done departmentally, the cost of weeding being prohibitive. As *boga medeloa* live generally for 3 years—unless attacked by root fungus—the shelter it affords is quite enough to nurse up the *bonsum* seedlings which at the end of three years generally attain a height of about 4'. Side pruning is necessary to give the *boga medeloa* the shape of an umbrella.

4. Transplanting :—This should be done with the first break of monsoon, when, generally, a week's or 10 days' continuous rain is expected. Seeds sown in nursery in January, watered twice a week, will grow into seedlings about 6" high, strong enough to stand transplanting. During the last two years nearly a lakh of seedlings have been raised and put out, but the mortality never exceeded 2 or 3 %.

5. The object of this note is to supplement any knowledge about *bonsum*, one of the finest timber tree of Upper Assam. There is always a demand for this timber. East Indian Railway has recently bought a huge quantity of *bonsum* squares 12" × 12" from Darrang for kiln seasoning, presumably for carriage building. The tree is tall with a tapering conical crown. The bole is clean and cylindrical, often straight as a pencil. But the only defect is it is highly buttressed, with the result that often as much as 10' or 12' of the butt end is wasted. The measurements of 5 trees given below, felled year before last, show to what enormous size they grow and how sound often they remain up to the very old age :—

Girth over buttress.	Approximate height (total).	Outturn in cubic feet in log.	Royalty -/3/- per cf. t. plus 12½ per cent. felling fee.
			Rs. a. p.
16'—10"	100	443	93 7 0
18'—0"	80	426	89 14 0
16'—0"	90	362	76 6 0
14'—0"	80	360	75 15 0
15'—3"	90	334	70 7 0

It is possible to raise this species on Rs. 30* per acre under		the shelter-wood method described
	Rs.	above. Natural <i>bonsum</i> patches
* Climber cutting per acre ...	2	show we can have a final crop
Cleaning and thinning includ-		of 50 trees per acre of 7' girth.
ing subsequent removals		A plantation within easy reach
per acre ...	6	of a Railway station should fetch
Laying out lines ...	4	Rs. 60 per tree <i>i.e.</i> Rs. 3,000 per
Hoeing lines in "thullies" ...	7	acre. Besides there will be interme-
Collection of seed ...	2	diate yields also of substantial
Sowing in "thullies" 2½' apart	4	value. From the ring counting
Weeding for 3 years (this is		done, we find that it takes about
really inexpensive under		
shelter-wood)...	5	
Total ...	30	
65 years to attain 7' girth, but this period is likely to be shortened		to 60 years when grown artificially.

REVIEWS.

MEDICINAL DRUGS OF INDIA.

BY B. S. MOHAN, HINDI ELECTRIC PRESS, LAHORE,
PRICE RUPEES TWO.

According to the author, the purpose of the book is 'to present reliable and at the same time relatively simple account about the usage of the indigenous medical herbs and drugs which abound in our country' and it is intended for "an average medical practitioner of the Western system especially in time when they are far away from the chemist's shop or on touring duty."

It appears that the book does not fulfil the aims the author has laid down. An average medical practitioner is not familiar with the indigenous drugs and their common names and, when he does know them, he cannot identify them properly and has to depend for the authenticity of the sample on the local 'pansari' (drug merchant) and, with such scanty knowledge he is likely to do more harm than good. This book will not therefore help him on occasions such as these. Unless the person is familiar with both the vernacular and the botanical names it is difficult

to search for any particular drug and an index of botanical names would, therefore, have been very welcome. In the absence of such an index the usefulness of the book is restricted to Northern India, since the vernacular names of even the most common drugs are totally different in Southern India. One reason why a medical practitioner of the Western system does not make as great a use of indigenous medicines as he should is, that these indigenous medicines and their doses have not been standardised. Further, the author has made no mention of the drugs that have been worked out on scientific lines by Indian investigators. For example, no mention has been made in the book of such important medicines as *Saussurea Lappa*, *Ephedra vulgaris*, *Psoralea corylifolia*, *Aconitum Chasmanthum*, *Artemisia maritima*. The scientific value of the book has been lowered by the omission of references to standard scientific works.

The book, however, will be useful as a compendium of household remedies for the treatment of ordinary ailments, since it gives the more important therapeutic properties of the more common medicinal herbs of India which are easily obtainable in the bazar. It also gives details regarding the proportions of ingredients and doses of some of the important Ayurvedic prescriptions. The book contains a lot of spelling mistakes, and is not good on the distribution of the species described.

H. C. K.

EXTRACTS.

THE VIRGIN FORESTS OF NEPAL.

There have been reports lately from countries as far apart as Britain, United States of America and India on the world shortage of timber, and in consequence the possible difficulty in years to come of obtaining sufficient wooden sleepers for the railways of these countries. It has been even said that in order to overcome this shortage in the world's supply, the railways of America and England are already experimenting with steel, concrete and cast iron sleepers, while here in India many hundreds of miles of rails are carried on metal sleepers, but whether this has anything to do with a shortage of timber or the price of steel as against that of wooden sleepers it is not the intention of the writer to discuss, specially as he has just returned from visiting a source of sleeper supply which appeared to be almost inexhaustible, in other words, "The Nepal Forests." Here within a few miles of the Indian Frontier is a Virgin Forest belt some 600 miles in length lying at the foot of the Himalayas containing magnificent trees of the finest known sal timber--trees whose girths are 18 to 20 feet, trees that have never been disturbed for a thousand years.

trees towering 100 to 150 feet in heighty mighty monarchs of a vast and unexplored virgin jungle.

At a small Forest Terminus of an Indian metre gauge railway one is met by a 2-foot narrow gauge railway on the engines and trucks of which the letters N. G. S. O. appear (denoting Nepal Government Sleeper Organisation) and a short description of this model railway and its purpose may be of interest. This line runs for some 31 miles right into the forest area crossing the Indian Frontier about half a mile from the junction with the metre gauge line. The standard track consists of 25 lb. per yard, flat-footed British Standard rails spiked to sal sleepers and is so well packed and maintained that such a thing as a derailment has never been known on this railway. The maximum grade on the line is 1 in 75 and there are no sharp curves on its entire length.

There are two passing loops between the Nepal Forest Railhead and the Indian terminus and at one point a sanded trap-siding is provided in case of a run away on the 1 in 75 gradient. Semaphore Signal posts control the loops at the passing stations and points are padlocked behind the trains just as on the big railways. The whole standard of this Toy Railway is so good that it only needs stone ballasting to be passed by the strictest Senior Government Inspector of Railways for the carriage of passengers at unlimited speed. The line crosses some 7 fairly large mountain streams and these are bridged by rail girders (75 lb. F. F. rails bolted together) carried on sleeper crib piers, providing a factor of safety and strength equal to at least 10 times the load that they are ever likely to support. It need hardly be mentioned that these bridges are not called upon to withstand the force of the monsoon floods as they are dismantled each year before the hot weather and are not again erected until after the following monsoon.

Owing to there being no maps of any description of this particular district which is for the most part dense jungle the alignment of the railway had to be made by the primitive method of locating by sound. Men being posted within sound of a whistle of each other and the jungle cleared in the direction from whence the whistle could be heard, until the place selected for the Rail Head Depot was reached.

During the 10 years this Organisation has been supplying sleepers to India, the railway had been shifted from area to area as occasion demanded and is in fact the fourth built during this period.

There are 3 trains of 21 bogie trucks, each capable of carrying 100 broad gauge sleepers. The trucks are 10-ton Pershing type of double bogie. Each of these trucks has brakes on all wheels controlled by a winch on the outside platform. A train when made up comprises 21 bogie trucks with an open bogie wagon in rear in which chairs are placed when there are any "Passengers to be conveyed." The full load is 320 tons equal to that of the famous "Royal Scot" on the L. M. S. Railway.

Now let us take a look at the stalwart little locomotives that haul these proportionately heavy loads. We note they are built by the Hunslett Company of Leeds and are of the 4-6-0 type. The side water tanks have a capacity of 375 gallons and the fuel bunker is designed to take 15 cwts. of coal. Coal, however, is not the fuel used in these engines as the cost of its transport would be prohibitive so that each engine is provided with a firewood truck, the fuel being the bark and wastage pieces remaining over after the sawing up of the sal trees into sleeper lengths.

The little locomotives with their wood tenders attached have electric searchlights fitted to each, and as these are identical with those provided on the E. I. R. Mail and Express Engines they look a bit "oversized" on the N. G. S. C. Railway locos, although they are a very necessary provision as trains run at night as well as in the day and some queer stories are told of the wild beasts that are caught and dazed in the powerful electric headlights, as these trains pant their way through the dense jungle at dead of night.

A fully loaded train carries 2,100 broad gauge sleepers approximately sufficient for one mile of standard broad gauge track and has a train staff of no less than 15 as every other bogie wagon has a brakesman and it requires the services of two of the 4-6-0 engines to haul it. On the rear wagon, which is an open truck used for stores, officials and "Passengers," the guard complete with red and green flags is carried.

The trains are worked to a proper time-table and are scheduled to do the 31-mile journey in 3 hours and the maximum speed allowed is 15 m. p.h.

A view of a train ascending the 1 in 75 bank is shown in No. 4, and it will be noticed that owing to the grade only one half of the complete train is hauled up at one time. There is a passing loop at the summit of this bank where the first portion is left while the locos go back for the rear portion. This arrangement being found more economical than providing Bank Pilots.

At the extreme end of this miniature railway one is confronted with a colossal Sleeper Depot—literally roads of sleeper stacks on either side of the line for a distance of least $\frac{1}{2}$ mile square and it is to this depot that the finished sleepers are brought. They come in carts, they come on camels, they come on elephants, distances of 10 miles and over from the very interior of the forest where the felling is done. Here as each sleeper is unloaded it is checked to see that the passing brand put on in the forest is in order before it is railed to India. It is all bustle and activity and one wonders why so much work is being done to fill up the depot which to an untrained eye seems already over-full with stacks and stacks of sleepers. However, there is a reason—4,200 sleepers are despatched every day from this depot and the whole organisation can only work from November to March while during this period the cold weather rains are expected and dreaded. The whole of the work is stopped in the event of heavy rain—carting to the

rail-head is impossible due to the sodden state of the ground and the narrow gauge line to India becomes water-logged and unsafe for the passage of the heavy trains while the mountain streams soon assume the appearance of inland seas threatening the sleeper crib piers of the bridges. So that in order to combat such a temporary stoppage a good deal of hustle and activity at this Rail-head Depôt is necessary in order that stocks can be maintained there. So important is this question of the weather that a special wire from Poona is received each day at the Headquarters of the Organisation giving warning of the approach of depressions.

The Organisation has been designed to supply anything from 6 to 8 lakhs of broad and metre gauge sleepers during the very short season available, an achievement of no small order when one realises that the operations are taking place at a distance of 250 miles from the nearest source of supplies.

At the time of the author's visit there were roughly 14,000 men employed on this work and 95% of the total labour was recruited from India, all these men receive a comparatively high rate of pay and appeared a most contented crowd. Although the organisation is in Nepal it gives employment to some 9,000 Punjabi sawyers (for all the sawing is done by hand), 3,000 Indian cartmen and a large number of skilled railway workers all of whom are drawn from India.

To attend to this forest population there are a number of Indian doctors, and a large Medical Store, while curious to relate serious crime is quite unknown among the staff possibly in view of the fact that none of them know what penalties there may be in Nepal for wrong-doers.

Leaving the Rail-head by elephant a tour of the felling and sawing area being worked was undertaken and to those who are unaccustomed to riding elephants "side-saddle" it may be mentioned that the first 7 miles are the worst, the second 7 miles being too painful for words and the last 7 are better done on foot! The whole area being worked this year was about 80 square miles and in order to get the timber conveyed to the railway, roads and clearing, were made and large gangs of Indian coolies are continually employed on road maintenance. The elephants, however, prefer to make their own way through the jungle ignoring the roads and because of this it was possible to see some of the real wonders of this Virgin Forest belt dense undergrowth, jungle grass 9 to 10 feet high, trees overlapping and intertwining even shutting out the sunlight when suddenly out of the darkness appears a small clearing where 3 or 4 mighty sal trees have been felled and here the sawyers are at work; the tree has been cut into 9-foot lengths and is being marked off for the sawing of the broad gauge sleepers (9' x 10' x 5') the sawyers are only paid for those sleepers which are "passed" and no sleeper is passed that shows the slightest trace of sapwood, wane, or other defects—hence is obtained a sleeper composed almost entirely of heartwood, the ideal so often laid

down in specifications on paper but so rarely laid down on a railway track !

In some cases two sleepers could have been cut from a log but as both would have shown a small amount of waste and sap it is decided to extract only the one sleeper and a perfect specimen is obtained. It will naturally be thought that under these conditions a large percentage of waste must result, but on the contrary, planks, scantlings and bed-legs are made from the timber left over from that required for these perfect sleepers.

It is interesting to know that in the Nepal forests no tree is felled unless its girth is 5 ft. 3 in. which represents an age of over 100 years. The record tree felled this season was 18 ft. 3 in. in girth and yielded 92 broad gauge sleepers and 30 metre gauge sleepers with the usual proportion of planks, scantlings and wood for bed legs, etc. This tree was estimated to be about 800 years old.

The standard of passing these Nepal Hill sal sleepers may possibly be considered very strict but in short no sleeper is passed 1st class unless it is perfect and to ensure that no unpassed sleeper ever reaches the purchaser everyone bears the Forest passing brand, which is again checked at the Rail-head Depot and once more at the transshipment station before being loaded up for the railways in India—a more stringent method of ensuring that only the best sleepers ever reach India cannot be imagined.

The huge army of labour necessary to run this organisation lives right in the forest in grass huts adjacent to the area on which they are working at the moment; food-stuffs are brought up from India, bazaars opened at convenient places and for 6 months this Sleeper Colony hidden away from civilisation carries on its work with a smoothness and efficiency unknown to us in India.

The climate from November to the end of March is of the finest cold nights (the thermometer registered 34 Fahr. during the writer's visit) and warm days, but after March the heat becomes intolerable and in the monsoon the climate is so unhealthy that even the inhabitants of Nepal (these are very few and far between) evacuate the forest area so that the whole of the Sleeper Organisation comes to an end, the railway is dismantled and the workers return to their homes in India to spend their savings and wait till the next cold weather when the majority of them return again to their labours in Nepal. It is a curious thing that many of the staff of this vast organisation have been employed for years with the N.G.S.O. and instead of taking up regular jobs in India prefer to do their 6 months in Nepal year by year.

A great deal more might be said about the magnificent scenery in this part of Nepal, the variety and number of the jungle beasts that prowl around the camps and huts of the workers every night, but all this is beyond the scope of the present article which is merely an attempt to

give a brief insight into an Organisation entirely unknown to most people in India which supplies a large proportion of the best sleepers used on some of the most important Railways of India to-day.

The author is indebted to Mr. J. V. Collier, the Forest Adviser to the Government of Nepal, and the Railway Board for permitting the publication of these notes.

(Indian State Railways Magazine).

LIBRARIANSHIP AND SCIENTIFIC RESEARCH.

The growing difficulty of the task of making the ever expanding mass of published information readily available to workers in every branch of science is a serious problem both in scientific and in industrial research. The value of a uniform international system of classification as the only effective way of dealing with the present enormous output of scientific periodicals was emphasised by most of those who took part in a discussion on the abstracting and classification of scientific literature which followed the annual dinner of the Chemical Engineering Group of the Society of Chemical Industry. Workers on the borderline and in the newer branches of science have suffered most from the absence of a uniform classification, and would gain most immediately by the adoption of the universal decimal classification of the Institut de Bibliographie, of Brussels. This system has already been adopted by a number of reference libraries, including the Science Library, and also in industry, and is used by the Royal Society (for its 'B' papers) and other societies in Great Britain and abroad. So far, the adoption of the international system has not been favoured by the British Bureau of Chemical Abstracts. This is due not to any difficulty in applying the system to the complicated case of chemistry, for the international system allows any chemical compound to be classified, but apparently to doubts as to the value of the system to chemists already familiar with a complicated system of nomenclature.

The adoption of a uniform international system of classification is, however, only a step towards the solution of the problem. A significant feature in the present situation is that in spite of the excellent abstracting services already available, most, if not all, of the large research associations of departments for scientific or industrial research find it advantageous to issue their own bulletins of abstracts. This is not necessarily a case of overlapping. In the first case, such bulletins will be limited not by sciences but by applications of science, and a particular bulletin of abstracts may cover engineering in several branches, physics, chemistry, and perhaps biology or medicine as they are applied to a particular field of industry. Again the abstracts in such a bulletin will not be limited to the journals which contain accounts of original work, but will include journals describing applications of such work, etc., and valuable ideas or suggestions are often taken

from the technical or trade papers, apart altogether from the commercial information, and other matter that is gathered in this way. Another feature may be the abstracts from patent literature or summaries of work carried out in the department or institution which is not published outside. A bulletin of this kind is essentially a record of current information received in the library, and rarely includes abstracts on the scale of those issued by Science Abstracts or the Bureau of Chemical Abstracts. Its purpose is to stimulate thought and to bring to the notice of those concerned the papers, patents, and other documents, internal or external which are of immediate interest to them. For this reason, promptitude of publication is an important matter. Such library notes may be in the hands of readers several weeks before the publication even of British Chemical Abstracts, which are noted for their promptness of publication.

One of the points which Major Freeth most stressed in his recent lecture *on the influence of technique on research* was the isolation of the modern scientific worker. Science lives far too much in water-tight compartments, and frequently men are unaware of first-class work going on within two or three hundred yards of them in another department. This is one result of the extraordinary specialisation of industry and of science, and it persists, if it does not increase, in spite of the widening scope of the abstracting services. The issue of a bulletin of the type just indicated affords a librarian some opportunity of breaking down the isolation of the scientific workers for whom the bulletin is intended. The smaller circle of workers for whom the bulletin is intended permits the issue of a document with rather more personal and vital interest than is possible in the case of one published for scientific workers generally, or even for one class of scientific workers. The shorter abstracts or notes are another advantage. They are much more likely to be read by those to whom it is sent than the lengthier abstracts. Few engaged in scientific or industrial research have not at times been overwhelmed by the mass even of abstracted information which seems to call for attention, and fewer still have diligently and consistently examined the whole. The smaller group of workers also enables the librarian to issue special notices directing the attention of individual workers to papers or publications likely to be of special interest or service to them. In this way a librarian may be able very considerably to assist the director of research who is often responsible for considerably more than the fifteen workers whose investigations he is supposed to be able to direct at maximum efficiency.

The efficient discharge of duties of this type depends very largely upon the personality of the librarian, and a technical librarian is now generally regarded as occupying a key position. His ability to select material for indexing and for issue in bulletin form will be influenced largely by the extent of his practical knowledge of the technical and manufacturing side of the industry. Some such knowledge is fundamental to the specialised work of indexing and classification, and only when the librarian is able to

use it in selecting material for his special requirements will industry reap the full value of the International Decimal Classification and improvements in the abstracts issued by the scientific societies.

Under modern conditions, a well-equipped and adequately staffed library is an essential feature of any large research department. The increasing volume of scientific literature has indeed enhanced the value of a literature search, and in a recent article* W. A. Hamor and L. W. Bass point to the increasing demand for chemical bibliographers, literature indexers, and the like, as evidence that this is widely recognised. The conditions for literature searches in academic work and in industrial research often differ considerably, and various factors which are emphasised by Hamor and Bass tend to greater thoroughness in the former case, apart from the actual library resources which may be available in the two cases. There is much to be said in support of Dr. S. C. Bradford's suggestion that the preparation of bibliographies or lists of papers dealing with specified subjects should be undertaken by libraries. A literature search is effected much more thoroughly and rapidly by a trained library staff than by the average research worker. The saving of time for actual research work may be quite considerable enough for the practice of entrusting literature searches to the library staff to become general in industry—perhaps more so if industrial research became organised, as Major Freeth suggests, by divisions of science instead of by divisions of practice.

The efficiency of the technical library for research purposes is, however, determined as much by the personality and enthusiasm of the librarian as by the mechanical perfection of its indexing system. His knowledge of the problems under investigation and their requirements, and his contact with the research staff, are the surest means of promoting contact and the resulting exchange of ideas and technique. The cramping or isolating tendency of the growing mass of recorded scientific information can only be countered by the play of intelligent individuality and enthusiasm.

(*Nature*).

FORESTRY AT THE ROYAL COUNTIES.

A most interesting exhibit of another type was that of Mr. John Evelyn of Wotton, a descendant of the famous silviculturist. This consisted of the woods record of the estate in 1774, showing the timber on each area, what was to be cut, what was to be left, and its value per cubic foot, etc. Had the ancestors of many of our present landowners taken such trouble their descendants might be better off to-day. There was also an account showing

* "Bibliochresia: The Pilot of Scientific Research," *Science*, 1930, 71, 375—378.

prices for estate work in 1787. An extract from this shows a distinct contrast with the prices of to-day:

	s.	d.
50ft. 2 in. white deals for a case ...	6	3
Oak cill, 5ft. by 8½in. by 3in. , at 5½d. per foot ...	2	2½
12ft. 1½in. yellow deal at 4d. ...	4	0
T. Richardson, labour for 1½ days ...	3	0
His son ½ day ...	1	0

(*Timber Trades Journal*).

INTERESTING INSTALLATION.

Meldrums, Ltd., Temperly, near Manchester, the specialists in raising steam from the utilisation of wood and other refuse, announce brief details of an interesting installation they have just completed for one of the largest tool makers in the Midlands. The refuse comes from the woodworking shops making handles for tools such as spades, rakes, saws, etc.

The plant deals with 2½cwt. of chips per day, and special feed chute is arranged for the rapid handling of the material. The material is placed in a trough and when the fire-door is opened the whole trough full of material is pushed into the furnace at once. This ensures that the fire-door is not opened more than is necessary.

On the top of the combustion chamber is placed a vertical tubular boiler which supplies steam for process work in connection with the tool-making.

As there is a surplus of gases available from the destructor they are passed through a water heater which provides hot feed for the boiler, thus giving a much improved steam output. The gases from both the destructor and feed water heater are passed through a dust catcher, effectually preventing any sparks or bits coming from the chimney.

The plant is a good example of the utilisation of waste material being put to profitable use and a very considerable quantity of coal is saved, which formerly had to be used before the plant was installed.

(*Timber Trades Journal*).

TRANSPORT NOTES.

In the last two or three years reports have been received periodically announcing the discovery of a new fuel for motor vehicle. Apparently most of these fuels have been manufactured from wood, and news is to hand of yet another fresh commercial spirit, this time produced from eucalyptus wood. The process is said to be both effective and economical, a heavily loaded motor-bus having been run from Madrid to Barcelona, a distance of 400 miles, at a cost of about 5s. The wood-gas will be thoroughly tested before being put on the market. The first official experiments will be made with a Panhard and Levassor 5-ton truck.

(*Timber Trades Journal*).

INDIAN FORESTER.

NOVEMBER 1930.

MUSINGS ON THE PURI FOREST DIVISION.

By P. W. AUGIER, P.F.S., BIHAR AND ORISSA.

Of all the forests of Bihar and Orissa those of the Puri Forest Division are perhaps the most interesting not only from the historical point of view but also from that of management. The Forester who attempts to pry into the jealously guarded secrets of nature will also find a source of never ending enjoyment there.

In 1805 the Khurda Raja rebelled and was defeated by the British who annexed his property which up to the present day, except for some minor alterations, forms the Khurda Khas Mahal. In 1817 there was a ragged attempt by one of his lieutenants to reinstate the Raja. The latter retired to his stronghold at the foot of Barunai Hill where he was besieged by troops hurried in from Ganjam and Cuttack, but when he found things going against him, he fled, but reconsidered his decision after a short time and gave himself up.

All records to which we have access show that the people had no rights in the forests. To shoot the king's deer, was a feat attended by grave personal risk to the physical well-being of the shooter, and it is not unlikely that the killing of tiger was regarded then as it is now in many states, not only as the king of sports but also as the sport of kings.

Under the new form of Government came an era of peace and prosperity. The whole estate was assessed at a ridiculously low figure. Population increased and consonant with this came an increase in cultivation and diminution, unfortunately very often indiscriminate, in the forest area. Up to 1870 unrestricted fellings were permitted and indulged in. Mr. W. C. Taylor's interesting Settlement Report of 1872 referred very pointedly to the absence of any form of forest conservancy and to the destruction of valuable forests of sal, *piasal* (*Pterocarpus Marsupium*) and *kongra* (*Xylia xylocarpa*) by people who came in from the neighbouring States of Cuttack, Puri and Ganjam, and carried off daily five and six hundred cartloads of timber firewood and bamboo sometimes in defiance of the Khurda Sarbarakars (headmen) and the *raiyats*, and sometimes in return for a trifling royalty to which the Sarbarakars had no right. "Government Officers appear to have an idea that the Government had no interest in the forest whatsoever and that the Sarbarakars should be allowed to fight their own battles as far as the preservation of the forests was concerned." Thus wrote Mr. Taylor, but his voice was a voice crying in the wilderness. Mr. James Taylor, son of the above gentleman, who had the very singular position of revising his own father's settlement also remarked very strongly on indiscriminate cultivation at the expense of good forest.

In 1870 all unsettled lands in the Khurda Government Estate were subjected to a mild form of forest conservancy. Mr. Gamble the then Bengal Conservator visited the forests in 1881 and reported on them. He described the *kongra* area around Chandka as 'the remains of what formerly must have been fine forest but now (i.e., at the time of his writing) consisted entirely of coppice shoots.' "It should be carefully preserved and managed" he wrote, "as it will prove valuable." That forest along with a lot of others have since been preserved and tended to the very best of our ability despite much unnecessary opposition and in the teeth of criticism and satire, and to-day bears good crops of *kongra* which are eagerly sought after at the annual auctions. We get between Rs. 60 and Rs. 70 per acre for them.

I could quote chapter and verse in a strain similar to the above giving descriptions of recognised bits of forest by "foresters of those grand old days," and giving their present descriptions and financial results. Never has the policy of the Forest Department, that of pegging away, been more completely vindicated than in the Puri Division. But "forests" is still a reserved subject managed by that most reserved of all subjects the forest officer, and so we continue suffering under that serious disadvantage, the complete inability of self-advertisement.

Those areas in which the spread of cultivation was least likely (*i.e.* in and around the prominent hills), were notified as reserved forest in 1885-86. The present Rajin Block, however, owing to a boundary dispute was notified in 1891, and all reserved forest was handed over to the Forest Department for management.

We will now dismiss the question of the Protected Forest in a short paragraph. As has been written before, Chapter IV of the Indian Forest Act operated from 1880 on all waste lands. The Khas Mahal authorities suddenly awoke to the fact that whilst government in the imperial sense had husbanded their forest resources, improved them and arranged for their perpetuation as all right-minded Governments should, they themselves, acting for the Government, had made no such efforts except by rules more honoured in the breach than in the observance, and they realised that the complete destruction of the forests would be merely delayed and not forestalled. House-building timber and other forest produce were decreasing out of all due proportion and suddenly there was there a great upheaval—something they considered must be done. It was strongly urged that the demarcated areas for the use of the people were necessary but no one desired that his particular bit of forest should be touched. Anyhow the best areas of the protected forests were demarcated during the years 1915-17 and the scheme for the blocks thus formed operated from 1919. These blocks were handed over to the Forest Department for management, whilst the Khas Mahal authorities retained the management of the undemarcated areas. Just at about this time the non-co-operation

movement was at its height. At a preconcerted signal, organised raids throughout the division took place on the demarcated blocks during which time the instigators of the raids lay "doggo". Punishment and apology followed. Some time later the Khurda Forest Grievance Committee constituted itself, posed as the mouthpiece of the people, and issued a fierce diatribe on the inefficiency of the department that had managed forest affairs scientifically, but with fruitless results. It inveighed against the lordliness of the superior officers and the rapacity of the subordinate ones (*sic*). It shut its eyes to the fact that four years of rest, since the time of the demarcation, was a totally inadequate period for denuded areas under scientific management to meet the heavy demands of the people. Its main plank was that now that the government had made futile efforts to manage forest affairs, the management should be handed over to the accredited representatives of the people. The writer of the next scheme of the Demarcated Protected Forests, bore these aspirations in mind, and upon Sarbarakars devolved the duties of enquiring into the wants of the tenants, of seeing that they got their allotted amounts and above all of enforcing a fair distribution of produce. The system of course presupposes a spirit of communism, the attribute of respecting one's neighbour's rights and the absence of nepotism. We will draw a charitable veil on the file in the office of the good S. D. O. dealing with wiggings and fines. However the scheme was revised and it operated from 1929. From 19 felling series the number was raised to 42 to allow the people exercise more easily their rights to collect produce and to graze their cattle. The staff of guards in the division was doubled to enable more effective patrol work so that the incidence of pilfering and illicit grazing would diminish considerably. It is, however, sad to relate that forest crime is still prevalent in the division and that people still steal from the neighbourhood rather than go a mile further to the coupe of the year to take their requirements. I say it with all the emphasis at my command for the benefit of the Khurda people even at the risk of being considered a platitudinarian by brother officers, that, given the most efficient staff of guards in the world but lack of

co-operation on the part of the tenants, the Demarcated Protected Forests stand very little chance of being perpetuated.

The prospects of the Demarcated Protected Forests are as gloomy as those of the Reserved Forests are bright. Their first Working Plan by Mr. Hatt covered a period of ten years ending June 1905. Its prescriptions aimed purely at the improvement of the forests and over half the area complete rest was enjoined and over the other half, light improvement fellings. Fire conservancy had been introduced immediately after the notice of reservation; Hatt stressed the success of the existing arrangements and elected not to change them. The demand for forest produce was not very large, but even from the very beginning, the division paid for itself. 450 acres of Miscellaneous Forest had been previously subjected to artificial regeneration of teak, and the same prescriptions were continued by Hatt. Whether the method originated in Puri or not, is unknown, but instead of clear felling and sowing and planting as is done now, lines 15' in width were cleared through the forest, and the space thus formed was planted with two rows of teak 5' apart in staggered formation. These lines were 15' apart from centre to centre. Results are very successful as viewed to-day, and though Burma and Nilambur may smile when they know that it takes 45 years to produce a tree 80' high and 4' 6" in girth in Puri, the local Forest Officer finds it most refreshing to see the way that the teak out-distances all indigenous competitors.

In July 1905, Monteath's plan came into force. He divided the forest into two main divisions, Coppice and High Forest. The latter included all the forest in the Southern Range and the former all the forest in the Northern and Central Ranges. A 30-year-rotation was enjoined in the Coppice with Standard or Simple Coppice Working Circles. In the High Forest he proposed cutting 300 sal trees annually of 4' 6" and over in girth, and based his figure on a 36-year-cycle and a total enumeration of the sal. The Miscellaneous Forest in the Southern Range was unsaleable due to remoteness, but supplied from its better portions areas suitable for artificial teak regeneration. Creepers were cut in certain areas, and the existing fire-protection arrangements

being extremely satisfactory, were continued. Encouraged by the success of the introduction of teak on the poor soils of the Northern and Central Ranges, Monteath prescribed the introduction of this species in the Southern Range. The method described above was altered slightly. Instead of having lines 15' apart, this distance was increased to a chain. A little later, the spaces between these lines were planted with teak at different experimental spacings. In most cases the inter-planting that was done 9 years later has caught up the original planting. From 1919, the *taungya* system was resorted to for artificially regenerating teak. A spacing of $16\frac{1}{2}' \times 22'$ was adopted to permit of the inter-cultivation by the tenants who raised crops on the areas for two consecutive years and who put in our teak plants only during the second. Their contract compelled them to another year's cleanings after which we took back the area. The mistake in spacing a subsequent Divisional Forest Officer tried to palliate by introducing a fifth plant into the centre of each of the rectangles thus formed. Needless to say the fifth plant never took. The original teak had gone too far ahead and the soil had undergone too considerable a change during the four or five years counting from the time of clear felling. It is an acknowledged fact that for artificial regeneration to be successful, it must be successful during the first year, and that each successive year's failure makes it increasingly difficult during the next. Later on a spacing of $11' \times 11'$ was tried but cultivators found it very unsatisfactory from their point of view as they do not hoe. A man-eating tiger one year and cholera the next caused them to finally give up *taungya*. We then resorted to $6' \times 6'$ departmentally for a year or two and the prescriptions of the 1926 plan provided for artificially regenerating 100 acres a year at this spacing. Up to date we are 65 acres in arrears owing entirely to a bad lot of seeds received once. We have about 440 acres of teak regenerated under the *taungya* method.

In the year 1919, the above plan expired. At about this time the Group and the Shelterwood systems appear to have been almost universally applied to the regeneration of High Forest sal and the furor extended to secluded Puri. The Group and nothing

but the Group was considered the only method of giving sal seedlings the start in life they required and the necessary amount of light and side protection to ensure continuous and good growth and therefore the Group System combined with the Girth Selection was applied to Puri. The extreme dampness of these forests which from Troup's monumental work "The Silviculture of Indian Trees" appear to fall into the category of rain forests made cleanings and clearings very expensive operations. The luxuriance of growth was extreme. And the sal which exists as small seedlings where there are mother trees (by actual count over an average bit of forest a tenth of an acre, there were well over 400) never seemed to get beyond the small seedling stage at all. Burnings were prescribed but more often than not they fell through on account of labour difficulties or untimely rain. The fellings that had been done under the Group System started ten years ago have been fruitless in their results. Weeds and undergrowth have both come up very strongly and there does not seem to exist a single instance to show the success of the system except on the steep or less gentle southern aspects. Here, as in the less moist localities, the predominating undergrowth is not *Actinodaphne angustifolia*, but *Webera corymbosa*. The writer has found that wherever the latter species exists with a sal overwood, the chances of obtaining natural regeneration are very good.

Another attendant species is the broom grass (*Thysanolaena Agrostis*) and it appears to the writer that this species is an indicator of sal and wherever this species is found in the High Sal Forest of the Southern Range sal seedlings in the advanced stages are almost always found in close proximity. There is a theory that before the forests of this division underwent reservation, they were much less damp than they are now and that the sal occupied considerably more extensive portions of the forests. The presence of sal now in the long Khedjuria valley, a very moist patch of forest, is attributed to the annual burning that area underwent at the hands of the local professional graziers who came in from Naya-garh State each year to pasture their cattle during the hot weather. The very word "Bhoinscote" people say literally means "the place where cattle assemble," and when the settlement of the

dividing line between Puri District and the neighbouring States of Nayagarh and Goomsur took place in the eighties just prior to reservation, the Nayagarh graziers were hard hit by the settlement that took away from them one of the places to which their cattle retreated when pasture in the plains had run out. To these graziers and to local villagers who lived scattered throughout the forest we attribute the change of sal from the sporadic to the gregarious state, and it is our contention that the chief tool with which the change was unconsciously brought about as fire.

Hatt and Monteath both remarked on the presence of sal regeneration everywhere and of the proper distribution of the age classes of sal. Monteath substantiated his statement by a complete enumeration. When in 1919 and 1920 his plan came up for revision his successor deplored the absence of regeneration and the predominance of the older age classes. The writer of this article remembers very well going up to Rajin during the hot weather periods of 1922, 1923 and 1924, and being instructed to set fire to the sal forest as he went along with the purpose of killing out that serious competitor evergreen undergrowth. He remembers too the low density of the undergrowth on the last year. In 1930 on his return to the division, he was surprised to see the rapid headway the evergreen undergrowth had made under the six previous years of protection from fire. He was, however, also agreeably surprised to see patches of sal regeneration here and there which he has no doubt came in during his absence from the division. Piecing all the above together, we can conclude that prior to 1881 the sal at first existed sporadically, but later on owing to grazing and especially to fire, it made great progress, and spread itself throughout the forest. After 1881 reservation and fire-protection helped the evergreens against the sal to its detriment, and he maintains that the only solution to the difficulty, is to burn our way back to the former stage which existed in 1881. How long it will take to accomplish this, one cannot say but it is likely that it will not be less than 20 years. In the meantime it behoves us to go back to the old selection system again during this period.

Floristically, perhaps Puri Division is perhaps the richest in the province as it includes both moist as well as damp species accounted for by alternating stages of being conserved and not. Some of the commoner species are sal, *piasal* (*Pterocarpus Marsupium*), *Dalbergia latifolia*, *Buchanania latifolia*, *Diospyros Melanoxylon*, *Bursera serrata*, *Garuga pinnata*, *Odina Wodier*, *Ougeinia dalbergioides*, *Dillenia pentagyna*, *Adina cordifolia*, *Walsura Piscidia*, *Schleichera trijuga*, *Pongamia glabra*, *Alangium Lamarckii*, *Vitex latifolia*, *Alstonia scholaris*, *Amoora Rohituka*, *Polyalthia simiarum*, *P. cerasoides*, *P. suberosa*, *Elaeocarpus robustus*, *Diospyros Embryopteris*, *Mallotus repandus*, *Dimorphocalyx glabellus*, *Psychotria adenophylla*, *Ardisia solanacea*, *Canthium didymum*, *Chasalia curviflora*, *Phyllochlamys spinosa*, and *Paramignya Griffithii*. These are only a few, but from them the reader will judge the type of forest.

The Northern and the Central Ranges too have many points of interest. Early in this essay, we made passing reference to their poor condition shortly after reservation. Throughout the keen observer will see signs of the struggle between the damper growth that has come in during the last fifty years thanks to the policing and the fire-protection enjoined during that period, and the drier growth that began to assert itself from the year 1814 onwards aided by unregulated cutting, grazing and firing. Succession among the undergrowth is also noticeable. We have *Randia dumetorum* competing with *Randia malabarica*, *Actinodaphne angustifolia* with *Webera corymbosa* and *Psychotria adenophylla*, *Dalbergia rubiginosa* with *Abrus precatorius*, *Vitis latifolia* with *Heptapleurum venulosum*, *Cryptolepis Buchanani* with *Aganosma caryophyllata*, and *Vallaris Heynei* with *Anodendron paniculatum*. There is no point in multiplying examples indefinitely—any knowledgeable oecologist will understand conditions obtaining.

Not only does the Division boast of sal and teak and *Xylocarpus xylocarpa* but also of *Casuarina* artificially introduced on the sea coast of Puri. In the early nineties, Hatt proposed the introduction of this species, but the "powers that be" threw cold water on his scheme; our existing plantation owes its

origin to the proposed operations by the Puri Water Works Commissioners who wished to surround by trees the reservoirs they were about to dig. To ensure privacy, and above all freedom from grazing, they asked the Forest Department to grow the trees and to constitute the area taken in hand a reserved forest.

Our work started in 1917 on three hundred acres. The facility with which the Casuarina took, the low price of acquiring land in the neighbourhood, the value of the Casuarina as a fuel, and the close proximity of Puri town with its large demand for fuel, were the incentives to the Department to continue extending the plantation, and we now boast of three thousand two hundred odd acres. Plantation costs varied a good deal. In the earliest days it was somewhere in the neighbourhood of Rs. 35 per acre, but given a good Range Officer with a turn for organisation, and large areas to regenerate, the costs soon reduced themselves to Rs. 9-1-0. Sometimes as many as 40 acres per day were planted up, no small achievement when one knows local conditions.

As I write, we have discontinued fresh acquisition, as its cost per acre has risen considerably since the inception of the work. The mere fact of our acquiring these barren wastes from time to time gave them a market value; moreover traction over sand by bullock carts, and we must rely on bullocks as the motive power for the extraction of our produce, is always a tedious and expensive business. Lastly each fresh acquisition had to be further and further from the town.

The steady deposition of sand blown up from the beach on to the neighbouring land, and the constant and often unruly breeze noteworthy of the Puri sea coast, have always been a thorn in the side of neighbouring cultivators, and the Casuarina plantation journal expresses the idea that once the mile wide of plantation running between the land and the sea attained maturity, cultivation raised in the lee of the forest crop would be materially benefitted.

There is now one disquieting feature in the plantation. For no apparent reason trees are to be seen dying off singly and

in groups varying from a few trees to several hundred in number. A recent careful estimate shows that about four hundred acres have been affected. The cause is unknown and the mortality appears to be spreading in a north-easterly direction which is also that of the prevailing wind. The trouble first originated in the windscreen according to the journal and one does not find this very surprising when one knows that the major portion of the original windscreen had been planted very close, in some cases the spacing had been reduced to 4' x 4'. No serious effort has been made to plant up the affected areas although several miscellaneous species have been tried, with varying degrees of success.

**STORAGE OF SEED OF CHIR PINE,
(PINUS LONGIFOLIA.)**

BY H. G. CHAMPION, I.F.S., *Silviculturist.*

It is somewhat surprising that, as far as can be traced, no one has recorded experiments on the retention of germinative capacity by stored seed of *chir* pine, as it is almost certain that such experiments must have been made. The question is of considerable importance in practice in view of the facts that *Pinus longifolia* only seeds well every two or three years, occasionally failing to give a serviceable crop over large areas, and that the seed is in large demand for plantation work in the southern hemisphere.

To obtain reliable data, a part of a consignment of seed received in 1928 from Rawalpindi Division, Punjab, was utilised. Germination tests were made of the clean seed on receipt in July/August 1928. One sample was then sealed in a tin, and another sample mixed with charcoal and hung in a gunny bag under the thatched roof of an open shelter. In May, 1929, further germination tests were made, and the samples again stored in the same way. Tests were again made in April, 1930, and are being continued to 1931.

The tests were made on Grunwald's porous plates, 100 seed for each test, with two to four repetitions. Germination was

completed in all cases in 3 weeks, so that the 21 day germination per cent. may be taken as the same as the germinative capacity, whilst the 14 day germination per cent. is appreciably less as will be seen from the table given below.

The seed was in all cases soaked 24 hours in water before the test commenced. The initial tests were done with the ordinary seed cleaned by winnowing only, but unfortunately it was not recorded what percentage failed to sink in water. After a year's storage, it was found that some of the seeds were dry, and hollow or cracked; the exact percentage of such seed was not placed on record by a regrettable oversight, but it was noted as about 20%. These visibly defective seeds were not used in the tests after storage as they were readily separated by flotation or winnowing, but to make the figures obtained more directly comparable with the initial data, a proportional reduction has been made (see the table below) before drawing conclusions.

RESULTS OF GERMINATION TESTS.

Method of storage.	Germinative capacity and 21-day germination per cent.			14-day germination per cent.		
	1928	1929	1930	1928	1929	1930
Sealed tin...	82±0.6	76±2.0 (95)	72±3.3 (90)	69±3.3	76±2.0 (95)	63±3.2 (79)
Gunny bag with charcoal		69±5.0 (86)	56±2.7 (70)	...	69±5.0 (86)	40±3.5 (50)
Number of tests ...	3 (4)	2	3	4	2	3

NOTE.—Figures in brackets shew actual germination recorded without correction for rejected empty hulls. In the initial tests, one repetition was rejected as differing from the mean by more than twice the standard error.

A repetition in 1929-1930, storing in a gunny bag without charcoal, gave a germinative capacity of 93.3 ± 1.2 on three tests after one year's storage, confirming the general results tabulated above though the 1929 initial test was not acceptable.

The figures given demonstrate that the seed of *Pinus longifolia* can safely be stored for two years and probably longer without serious loss of fertility, in fact were light seed floated off before storage, it is probable that the high germinative capacity of about 85 to 90 would be recorded. It is of course necessary to keep the seed properly dry, and sealing in a tin after thorough drying before the damp season gives $16 \pm 4.2\%$ better results after 2 years than storing in a bag, the figures after one year storage being 8 ± 5.4 .

It is usually found that germination is somewhat slower with stored seed but this does not hold in the present investigation, as after two years no significant difference is apparent.

Although there have been defects in the carrying out of this petty investigation, the general result is clear and appears worth publishing.

A NOTE ON THE SO-CALLED TEAK OIL.

BY S. KRISHNA, BIOCHEMIST, AND S. RAMASWAMI, UPPER
GRADE ASSISTANT, MINOR PRODUCTS SECTION, FOREST
RESEARCH INSTITUTE, DEHRA DUN.

It is commonly stated in works on Indian Forestry that teak wood contains an oil to which the immunity to insect attacks is due. In some of the books it is stated that the quantity of this oil is so large that it can be and is used as a substitute for linseed oil. Gamble, for instance, in his *Manual of Indian Timbers* 1922, pp. 526, 531, writes that "teak wood is characteristically scented and containing an oil which is easily perceptible to the touch and is preservative. When quite fresh, teak hardly floats, but when seasoned it floats easily and the oil in the wood prevents its getting water-logged". And on page 532 he further states that "the durability of teak is probably due to the large amount of oil contained in the wood. This oil is used medicinally, as a substitute for linseed oil and as a varnish, but it would seem that its extraction as an oil is difficult, but as a tar is comparatively easy". Similar observations have been made by other writers. In *Silviculture of Indian Trees*, Vol. II, p. 698, Troup writes that

"heartwood in teak is golden yellow, sometimes with dark streaks, turning brown with age, oily, with a characteristic odour". The writer on the Indian Woods in *Raw Materials of Commerce*, Vol. I, p. 380 (1928-29) says that "teak is immune from attacks of white-ants, and is extremely durable in most climates. When once seasoned it does not warp, split or crack, as is unaffected by contact with iron, owing to the presence of an oil. As the wood does not ignite readily, it finds a considerable use as a fireproof material". This last statement is truly remarkable, that a wood soaked with an oil proves to be fireproof material.

From the above it is apparent that a considerable confusion exists in the forestry literature regarding the oil obtained from teak, even though in standard works such as the *Dictionary of the Economic Products of India* (1893), Vol. VI, part IV, p. 10, by Sir George Watt, it is stated that "teak wood has been examined by Dymock who states that it yields on distillation an opalescent distillate impregnated with resinous matter, but no trace of essential oil could be obtained". Dymock in *Pharmacographia Indica*, Vol. III, pages 62—66, writes as follows: "As a rule white ants will not touch teak wood, and the use of teak wood tar has been suggested as a remedy against these destructive pests. The wood has a peculiar aromatic odour. The tar obtained from it is black and opaque when properly made, but when prepared from partly dried wood it is mixed with the sap and forms a greyish brown emulsion. The seeds are of the size and shape of sesamum seeds; they are very oily, but the difficulty of extracting them from the nuts would make the oil very expensive. It is bland fatty oil, free from any peculiar odour. Teak wood yields on distillation with water an opalescent distillate impregnated with resinous matter, but no trace of essential oil could be obtained when operating with 126 lbs. of fresh saw dust from Indian teak". This confusion about the existence of an oil in teak has evidently been caused by the failure on part of the authors on books of forestry to consult the standard works of reference.

Teak wood has been examined by some chemists and no essential oil has been reported to be present. In this connection

certain relevant matter may be quoted from a paper in the Journal of the Chemical Society, London, 1887, p. 368, by R. Romanis, D.Sc., Rangoon College. "It is commonly stated that teak yields an oil by distillation which is used as a varnish. Last year a specimen of this varnish was required for a collection of forest products, but it was found that the natives of the country knew nothing of it, and there can be no doubt that the statement referred to originated in a confusion between teak tree and the *kanyin* a species of *Dipterocarpus* which yields *gurjun* oil and a fine timber. It was desired to ascertain if the oil could not be extracted in any other way. On examination, I found that alcohol extracts about 6% of a soft resin from teak but no oil or varnish. This resin is a mixture of several substances when extracted from freshly cut teak, it is entirely soluble in chloroform, but the resin from wood that has been long exposed to the air is only partly soluble, this change is due to oxidation. It was found that the resin melts below 100°C and gives off volatile products, principally a substance that sublimes in dendritic forms and crystallises from alcohol in spiral or in stellate groups of prismatic crystals. It is also found as an efflorescence in soft feathery crystals on the surface of the resin when this is kept for some months".

"When the resin is distilled the distillate is a felted mass of crystals having a sweet smell like that of myrrh or incense, whilst a black shining coke is left in the retort, the crystalline substance may be purified from adhering oil by recrystallisation from hot alcohol but it seems to retain the last traces with great obstinacy. When teak is exposed to destructive distillation the following products are obtained:—

Heavy tar	...	...	...	10.6%
Watery distillate	...	...	...	36.0 "
Light oil (tar oil)	...	...	...	3.4 "
Charcoal	...	...	...	35.0 "
Uncondensed	...	...	...	15.0 "
				<hr/>
				100.0

The tar contains the crystalline substance in considerable quantity, it may be extracted by adding an excess of caustic soda when much heat is evolved and the substance is precipitated as a curdy mass which soon becomes crystalline. This crystalline compound is quinone $C_{18}H_{16}O_2$ ".

The supposed use of 'teak oil' as a substitute for linseed oil would suggest that it is of the nature of a fixed oil, such as are found in seeds. If such an impression is present it may at once be said that woods usually contain essential oils, as distinct from fixed oils, and the authors of the note are not aware of any wood which is known to contain a fixed oil. It appears to be not improbable that the oil frequently referred to in *Tectona grandis* Linn. may in reality be the tar already described.

SACCHARUM ARUNDINACEUM RETZ.

By C. E. C. FISCHER, I.F.S. (RETIRED), KEW.

On page 339 of the *Indian Forester* of August 1930, Mr. R. N. Parker has given an interesting account of this grass. He states that "what is believed to be the type of the species is in the British Museum", but recent lights on the subject shows this belief to be incorrect.

A small, apparently overlooked, collection of the plants sent by Koenig to Retzius, preserved in the Herbarium of the University of Lund in Sweden, is now on loan to the Kew Herbarium and proves full of interest. It includes many of the types on which the descriptions in Retzius' observations were founded and among them *Saccharum arundinaceum* and *S. bengalense*. The latter appears to be identical with *S. Munja* Roxb., but not with *S. arundinaceum* Retz. as thought by J. D. Hooker (Fl. of Br. Ind., VI, 119). The description of *S. bengalense* in Retz. Obs., V, 16, however, seems to have included spikelets of *Arundo Donax*. These details have been worked out by Mr. C. E. Hubbard.

It is proposed to publish a complete account of the collection referred to in the Kew Bulletin. Unfortunately the result

of the examination involves several changes in the nomenclature of familiar plants; this is unavoidable under the international rules.

A WOODEN SLEEPER.

It was with interest that the writer read in the July issue of the *Indian Forester* a Railway Engineer's article on some aspects of the sleeper question; the impression conveyed at the time of reading was that the wooden sleeper had been tried and had been found wanting when compared with the cast-iron and the steel sleeper.

There were, however, several interesting points in the article which remained to be made clear and it was with the object of further enlightenment that the writer now draws attention to these points.

One of the main objections to the wooden sleeper appears to be the railway man's bugbear creep; why should there be more creep with a wooden sleeper than with any other and what is the cause of this creep? The writer believes that this point has never been explained, the rails creep and not the sleepers so that if the anchorage is adequate it would appear that there should be no creep. If, however, like one railway the writer knows of, no chains are used and the heaviest locomotives in India are retained on wooden sleepers with the aid of dog spikes alone, what will not happen. Creep—of course there will be creep and sometimes a crash but is that the fault of the wooden sleeper?

It was also mentioned that with wooden sleepers special contrivances had to be used to prevent creep, there again it would be of interest to know what these contrivances are and what they cost; all the writer has seen are iron chains either with a spring retainer for the rail, often as not replaced by a wooden wedge or else the dog spike.

The damage by cinders mentioned is negligible, as the writer recently saw sleepers which had been laid on a main line

for 16 years and were still usable and in use though they did bear the white cross of condemnation but not for damage done by cinders.

Another point mentioned is that the scrap values of these sleepers are practically nil, true, but if a specific size of sleeper be considered, *viz.*, the broad gauge, is it not a fact that often on removal as unfit for further use on the broad gauges, these sleepers are converted to metre and narrow gauge sizes and then render years of useful service? If this is so a definite saving is effected and a real and practical advantage over the iron or steel sleeper obtained.

Another point which is debatable—is it or is it not a fact that wooden sleepers give better running? To the uninitiated, this requires further explanation as to how sweet running of trains at home is obtained on wooden sleepers and that at a speed which has not yet materialised in India as opposed to the jolting on the Indian railway where we have all the three types of sleepers in use and one is as bad as the other.

Finally it would be of interest to know whether weight of rails effect the permanent way, especially the sleepers, as it would appear the weight and size of the modern locomotives is out of all proportion to the thin light rails they travel over often with enormous loads. Would it not be possible to alter sizes of wooden sleepers at a comparatively small cost for longer service and better running and retain the difference in cost of the cast-iron and steel sleeper for a more adequate rail.

TUNG OIL IN BURMA FROM ALEURITES SPP.

By C. W. SCOTT, I.F.S.

In the *Indian Forester* for April 1929 there was reproduced an article by "H. C. B." from "Capital" in which it was stated that large quantities of oil fruits from *Aleurites triloba* (*moluccana*) were available from Burma. The statement is incorrect and it appears desirable to give the main facts as at present known.

2. *Aleurites fordii* does not occur naturally in Burma. It is the higher altitude species yielding the Hankow variety or true

tung oil. *A. montana* occurs naturally in only one remote part, Kengtung of the Shan States of Burma, *i.e.*, on the north-east frontier. Even there it is scarce. It is the lower altitude species which yields the Canton or Wuchow or wood oil variety of *tung* oil.

A. triloba (*moluccana*) occurs fairly commonly as a planted roadside and monastery tree in the Shan States of Burma. It is there mis-called *kanyin-ni*, a name applied in Burma proper to *Dipterocarpus* spp. The confusion is due to the fact that both trees yield oil. It is not known just what supplies of *A. triloba* are available in Burma but they are probably small and certainly not as large as mentioned by "H. C. B", *i.e.*, 10,000 to 15,000 tons of fruits per annum.

A. triloba does not appear to be well known in Burma under the name *ngabauk* or *tawthitcha* as stated in Rodger's Handbook, p. 81. Those names are more usually applied to *Dracontomelum*.

3. A product known as "Shan oil" is used in the Burmese lacquer trade in mixture with *thitsi* oil (*Melanorrhoea usitata*) and cinnabar for red effects. It is obtained from the Shan States from *A. triloba*. In the Shan States the oil is used also for lighting and is obtained sometimes from the fruits and sometimes from the stem.

4. The oils of *A. montana* and *fordii* have been examined and compared with that of *A. triloba* by a distinguished Chemist Dr. J. L. Simonsen, *vide* Indian Forest Records, Vol. X, Part II. The chief result was that *montana* and *fordii* yield valuable fast drying paint oils and *triloba* does not.

5. The Federated Malay States have analysed the oil of *triloba*, there called *lumbang* oil and found the same defect, so much so that if the dilution of true *tung* oil with *lumbang* exceeds 20% the blended oil falls below the standard required by the American Association of Paint and Varnish users.

6. Specimens of the fruits and oil of *A. triloba* from Burma have been collected and sent to Kew for examination in the faint hope that the oil of the species as grown in Burma may be

superior to that of the species as grown in Malaya. If the oil did prove valuable, cultivation of *triloba* would be easy in the Shan States. *A. fordii* is doing well in experimental cultivation in the higher western parts of the Shan States where *montana* has so far proved a failure.

WEANING OF SAROJINI ELEPHANT.

By J. BANERJI, I.F.S.

Born of captive parents, Sarojini was as healthy and playful as any of her wild sisters. Her father "Emperor" is a first-class tusker, her mother "Netravati" is an active cow and she herself was born in captivity on 11th February, 1929. "Bessie", a captive cow, had once run into a wild herd; she was found pregnant when she came back and her calf "Chandra" was looked upon as an example of health and strength. But "Sarojini" stood second to none in general fitness.

Weaning is generally done when the calf is a year and a half old. Sarojini's weaning fell due on 12th August, 1930. Due to want of a tusker, weaning could not be carried out on this day; it was on 23rd August 1930, when I had Tino to spare, that the weaning was successfully carried out.

At least two elephants are required for weaning; but here I did it with Tino alone, who is a tusker of ordinary merit.

The kraal was made ready beforehand. The floor was swept clean. Extra horizontal and vertical bars were tied on to the normal number of posts forming the framework of the kraal. This was to prevent the enkraaled calf from putting its head out and getting itself strangled. Sufficient jaggery and bamboo leaves were kept ready; a log was scooped out to form water basin and was placed along one side of the kraal.

Netravati marched with Tino and was brought near the kraal. Sarojini was playing about. She was first given a piece of jaggery, which she liked very much. She was then tempted with bamboo leaves. Meanwhile Netravati, her legs hobbled, was tied on to Tino from the body cylinder. When the next piece of jaggery

was offered, Sarojini came straight into the kraal;—bang went the cross bars. For two pieces of jaggery, she lost her freedom with wild trumpets, she charged straight at the cross bars; but we were too quick for her; within a minute all the bars were safe home, and crosspieces tied.

Now Netravati understood the game. With all her might, she made for the kraal, actually dragging Tino with her, till she came beside her calf. Then began the struggle; Tino tried to draw her away, while she would not retrieve an inch. Tino yelled, Tino sat, Tino pulled, but his manly (?) strength failed before a raged lady. Netravati threw all her weight on one side and stood firm like a rock. This unequal tug-of-war went on for about an hour. Sarojini meanwhile went round and round inside the kraal, with wild steps, her eyes red, trying to force her head through.

An hour's struggle made Netravati tired, I then suggested to have her dragged like a log. The chain round Tino's body cylinder was taken off, and his drag chains were brought. Netravati's front legs were hobbled, and these were tied on to the drag chains of Tino. This proved very effective and Netravati began to lose ground. Slowly Tino gained ground and Netravati found all her efforts to be of no use. Lady-like, she followed Tino, casting every now and then a longing, lingering look behind.

Sarojini was given a good wash, plenty of jaggery and bamboo leave to initiate her into captive life. Netravati was taken away and tied for three days. That evening I found tears flowing from her eyes; she would not take her normal food, and kept trumpeting off and on.

Sarojini was taken out of the kraal on 13th September, 1930. Twenty days training made her quite a social lady except that she *salaamed* every one for sugar-cane pieces, rather unmannerly for society.

At the moment of taking her out of the kraal, she stopped short at the door and would not come out. Mrs. Sarojini does not want Swaraj!!!

THE REPAIRS AT RANGOON TO MISS AMY JOHNSON'S AEROPLANE.

By C. W. SCOTT, I.F.S.

In the course of making the first solo flight by a woman from England to Australia Miss Amy Johnson had the misfortune to damage her plane at Insein on the outskirts of Rangoon. When landing on a small football ground she overran the free space and struck her right wing against the iron post of a fence breaking three of the wing ribs, including the more important rib next the fuselage. The propeller also was smashed and one tyre was badly cut.

She carried a spare propeller which was duly fitted and the tyre was soon patched up but the wing damage involved detaching the starboard wings, removing the fabric over the broken ribs, making and fitting new ribs, recovering with fresh cloth and redoping with cellulose.

The repairs were effected by successful team work on the part of various people. The new wing ribs were made of a Burma timber, *thitmin* (*Podocarpus latifolia*) in the Forest Department workshops at Rangoon. They were an exact copy of the broken ribs and were turned out within 8 hours of receipt of those ribs and within 24 hours of the mishap. The repairs stood up well as long as they were wanted.

Thitmin had previously been used for aircraft work by the Air Survey Co., Ltd., who were employed by the Forest Department for the air surveys in Burma in 1924-25.

THE FORMATION OF SPRING AND SUMMER WOOD IN ASH AND DOUGLAS FIR.

BY L. CHALK, M.A., D. PHIL.

In the Oxford Forestry Memoires, Number 10, 1930, a valuable contribution is offered to the data thus far available in relation to the formation of seasonal growth rings in trees, and to the growth of the so-called spring wood and summer wood portions of those rings. The work described in the Memoir was undertaken with a view :—

- (a) to determining the period of the growing season, and
- (b) to observe the affect of external conditions.

Six Douglas fir trees (*Pseudotsuga taxifolia* Britton), three common ash (*Fraxinus excelsior* L.) and three Italian ash (*Fraxinus oxycarpa*, Willd.) were studied.

The Memoir is divided into three parts, the first of which deals with the inception, progress and termination of xylem growth and the period of formation and development of its different components; the second with the independence of spring wood and summer wood formation and their correlation with climatic conditions; while the third part is devoted to the effect upon diameter growth of dominance and suppression and the dependence of the production of wood material on the quantity of foliage. It also contains a reference to rotholz formation.

Part I of the Memoir is based on the study of living trees of Douglas fir and of the two species of ash mentioned. In this

work the technique followed was that developed by Dr. H. P. Brown, namely, the removal, at given time intervals, of small blocks of wood from the stem of the tree for microscopic examination. The data discussed in Parts II and III are derived from the study of the Douglas fir trees only, which were felled for the purpose.

The observations as to the beginning, progress, and termination of cambial activity, while adding a valuable contribution to the considerable mass of data already available, indicate the necessity for still further investigations. Some observers report the beginning of thickness growth in the twigs, others in the stem, the base of the crown or elsewhere. The author has reported the first thickness growth in the stem of ash and in both the base of the stem and the 1-2 years shoots in the Douglas fir. It would seem to be desirable to conduct an investigation of this nature on a number of trees and extending over several years.

A point of considerable interest which emerges from this report bears on the relation already observed between growth rate and strength of timber. It has long been observed that rapid growth coniferous wood has a tendency to weakness and that the reverse is the general case with ring porous woods. The observations contained in this Memoir indicate that open grown Douglas fir, which is, of course, of more rapid diameter growth than trees in congested stands, continues to produce spring wood for about 2 weeks longer than is the case with close grown trees, with the result that the percentage of strong summer wood in the year's growth is correspondingly lower in the case of former specimens. As opposed to this it was observed that the maximum growth rate of ash occurred after the middle of June, that is, after the tree had begun to produce strong, dense summer wood.

The second part of the Memoir indicates a relation between the spring wood production and the May-June temperatures, and a certain dependence of summer wood volume on the June-July August rainfall.

The very large amount of painstaking work recorded in the third part of the Memoir has revealed the fact that in Douglas fir the wood produced in a year's growth was from $1\frac{1}{2}$ times to $2\frac{1}{2}$ times the dry weight of the needles, and that the production of wood was apparently *more dependent on the old needles than on those of recent growth.*

Dr. Chalk is to be congratulated on a most interesting and valuable contribution to the subject with which he deals, and it is sincerely to be hoped that he and other investigators will follow the matter still further by means of investigations covering the growth history of a number of trees for a period of consecutive years.

L. N. S.

NATURAL HISTORY—ANIMALS.

By GEORGE JENNISON, M.A., F.Z.S. Published by A. & C. Black, Limited, London. Price seven shillings and six pence.

This is a popular book of reference to the animal kingdom. Representatives of each genus and many species have been described with special attention to size and in particular the height to the shoulder and length from shoulder to rump; the general and colour, and the size and form of all exterior characteristics. The descriptions have been taken in most cases from the collections at the Belle Vue Gardens, Manchester, or from the Zoological Gardens, London. We think that this rather tends to limit the usefulness of the book.

On page 202 we read "The elephant reaches maturity at about 20 years. The longevity of these animals is much exaggerated, authenticated instances of centenarians are very rare and domestic elephants show every sign of old age after fifty years of captivity; few live so long." On page 205 in the description of the Indian elephant, it is stated that the life is only 30 years. This age must be based on records of animals in captivity and living under very different conditions from the

captives in India. We certainly think 30 years is short for the life of an Indian elephant, and in the Forest Department they are only beginning their useful life at the age of 20 to 25 years and have been known to go on to a ripe old age. There are over 300 reproductions from photographs of all the animals described, and 16 full-page illustrations by E. H. Fisher. The book will be very useful to the general reader and to those interested in animals.

EXTRACTS.

JUNGLE IN RELATION TO MALARIA IN BENGAL.

By M. O. T. IYENGAR, Entomologist, Bengal Public Health Department,
Calcutta School of Tropical Medicine.

The term "Jungle-fever" as commonly used refers to a severe attack of malaria and it is a common belief among the lay public (and not an infrequent one among medical men as well) that jungles are malariogenic. We frequently hear of jungle being intensely malarious, and that a single excursion into the jungle would be enough to bring on an attack of malaria. In certain localities, the local people attribute the incidence of malaria to the proximity of the jungle and they believe that a clearance of the jungle would reduce malaria. Some medical men have strong views on this point and would trace an attack of malaria to a visit to the jungle. They have pressed for a clearance of jungle for a mile all round the village or habitation as a protection against malaria.

My observations on the jungles in the province of Bengal show that they are not connected with malaria at all, but on the other hand actually form a protection against the breeding malaria transmitting species of *Anopheles*. It will be of interest, therefore, to record these observations on the different jungle areas in Bengal.

Some misapprehension may occur in regard to the term 'jungle.' In using this term in the present article, I mean an uninhabited land covered by forest trees, shrubs or thick brushwood, tall and thick enough to produce shade and prevent the exposure of the land surface to sunlight to any appreciable degree. The height of the trees and shrubs is not of importance

as they may be very high or quite low. The vegetation may have been artificially planted or it may be composed entirely of natural jungle flora. Scrub-jungle consisting of straggling low-lying shrubs, pastoral jungle, and savannahs do not come under the term 'jungle' as discussed in the present article. The undergrowth of weeds and clumps of bamboos commonly occurring in the vicinity of houses and villages in the Deltaic Bengal and locally known as *jangal* does not come under this category and is not discussed in the present paper.

Jungle regions in Bengal.—Jungles occur in different parts of Bengal. We have the hill jungles of the mountains on the north; we have also the sub-montane jungles in the *Terai* and the *Duars*, the foot-hill zone. Lastly we have the mangrove jungles in the Sunderban area, the estuarine zone of Bengal. The sub-montane jungle is that which comes in for much blame as being malarigenous since the sub-montane zone is intensely malarious. The Sunderban jungle is less frequently blamed as being responsible for the malaria in the neighbourhood. But no complaints are heard with regard to the jungle in the hill areas, there being very little malaria in the hill zone.

Hill jungle.—Montane jungles were investigated on three occasions. The extent of breeding in these jungles is small and is restricted to the rainy season. Four species of *Anopheles* occur in the hill jungle in Bengal, namely *A. gigas* var. *simlensis*, *A. aithenii*, *A. lindesayi* and *A. annandalei*, and none of them has been known to transmit malaria. Owing to the elevation, however, there is little or no malaria in the hill region and as such the question of the influence of the hill jungles on the local malaria does not arise.

Sub-montane jungles.—Sub-montane jungles occur throughout the foothill region in Bengal and cover parts of the *Terai* on the west and the *Duars* on the east. This tract was at one time covered by dense natural jungles of the type of the 'tropical monsoon forests'. They have been extensively cleared for purposes of cultivation of the land, chiefly for tea plantations. The sub-montane zone has a rich anopheline fauna and it is notorious on account of its malariousness.

The question of *Anopheles* breeding inside the jungles in the sub-montane zone has been investigated in some detail since it is not infrequently that one hears of the unhealthiness of an area as being due to the proximity of the jungle. As the matter is concerned with the health of a large population consisting of labour and staff employed in the tea industry and in forestry, several areas in this zone have been investigated in detail to obtain accurate information about the anophelines breeding inside the jungle and those breeding in the cleared areas. The results of these investigations are discussed below:—

1. A large belt of the jungle land occurs on the north of Meenglas and Dalinkote, two adjacent tea plantations situated in the hyperendemic area

in the Duars. This jungle is quite close to many of the labour lines of the estates and during the rainy season the jungle has numerous streams. It was desired to ascertain if the jungle was in any way responsible for the high incidence of malaria on these estates. The anophelines breeding inside the jungle were investigated during different seasons for several years and species found within the jungle were *A. aitkenii*, *A. barbirostris*, and *A. leucosphyrus*, the last mentioned species breeding in stagnant pools. *A. aitkenii* and *A. barbirostris* were the only species found in streams within the jungle; out in the open, the same streams were found to breed many other species, for example, *A. maculatus*, *A. minimus*, *A. jeyporensis*, *A. culicifacies*, *A. jamesi* and *A. majidi*. The innocuous forest species breeding in the streams in the jungle are replaced, when the streams emerge in the open, by species known to be malaria transmitters or suspected to be such. These observations are interesting as showing how a jungle is perfectly healthy in contrast to the open area which is decidedly malarious. There is further support to this in the fact that the labour lines situated close to the jungle are less unhealthy and have a lower spleen rate than those situated in the centre of the plantation. The explanation of this lies in the fact that in the case of lines situated on the forest edge, the breeding of the carrier species occurs only on one side, while on the forest side there is none. On the other hand, lines situated in the middle of the open area, have breeding of the carrier species occurring on all sides.

2. Madarihat in the Duars, situated in a clearing in the jungle area, is an intensely malarious place. Its population has been getting thinner on account of the unhealthiness of the station and local opinion pointed to a jungle area in the vicinity of Madarihat as being responsible for the malariousness of the station. A survey of the station area and its vicinity showed that in the open area outside the jungle, *A. minimus*, *A. maculatus*, *A. culicifacies*, *A. fuliginosus*, *A. sinensis*, *A. vagus* and *A. barbirostris* were quite common, while within the jungle, *A. barbirostris* and *A. leucosphyrus* only were found. The anophelines breeding in the open include several species which are well-known carriers, while the species found inside the jungle are not concerned with the transmission of malaria, at least so far India is concerned.

This investigation shows the innocuousness of the jungle from the point of view of output of carrier anophelines and as such, jungle cannot be regarded as causing the malariousness of the station. The age of the jungle does not seem to produce any difference in regard to the extent to which anophelines breed. In this connection, jungles of varying ages, from 5 years onwards to 25 years old, were investigated at Madarihat and at Sukna and they seem to behave entirely alike in preventing the breeding of carrier species.

3. Some detailed work was carried out at Sukna, a small station in the Darjeeling Terai in the submontane zone, regarding the influence of jungle on species of *Anopheles*. *Anopheles* surveys of the jungle area were

carried out on several occasions during 1928 and 1929 and it was found during each of these surveys that the species of *Anopheles* found inside the jungle were different from those found in the cleared area. Inside the jungle were found breeding, in streams *A. aithenii*, *A. aithenii* var. *insulaeflorum* and *A. barbirostris*, in the ditches and depressions *A. leucosphyrus*, *A. aithenii*, *A. aithenii* var. *insulaeflorum* and *A. barbirostris*, and in tree holes *A. annandalei*. In the cleared area out in the open, these species were replaced by species like *A. maculatus*, *A. minimus*, *A. maculipalpis*, *A. fuliginosus* and *A. philippinensis*, all of which are known transmitters of malaria. If we follow up the course of stream, it is easy to demonstrate how in the open area malaria transmitting species are very common, while the same stream inside the jungle breeds an entirely different set of anophelines. Whenever deforestation is carried out, the harmless jungle species of *Anopheles* disappear and a total change in the anopheline fauna of the water is brought about by the clearing of the jungle.

4. Similar observations have been made at other places close to Sukna situated in the submontane zone, e.g., Kadma, Bengdubi and Sevoke.

5. At Rajabhatkhawa (Jalpaiguri district), a locality notorious on account of its malariousness and which has a spleen rate of above 90 per cent., it was interesting to find how at the edge of the jungle and the open area, heavy breeding of *A. maculatus* and *A. minimus* occurred, while a few yards within the jungle the breeding of these species stopped altogether.

6. At Samsing Tea Estate (Duars) which is at an elevation of 1800 feet, a dense jungle exists on the north and west of the estate. The jungle area was entirely free from *A. maculatus* and *A. minimus* which were found breeding in the open area, the species of *Anopheles* found within the jungle being *A. lindesayi* and *A. aithenii* which are not usually if ever associated with malaria. On this estate there are two coolie lines, one which is close to the forest boundary on the north and the other which is situated in the centre of the plantation. The spleen rate of the lines near the forest is much lower than that of the other lines and the former is decidedly the healthier one.

7. The District Medical Officer stationed at Rangamati, the headquarters station of the Chittagong Hill Tracts, drew attention to the intense malariousness of the station and expressed his belief that a dense jungle close by was responsible for the high incidence of malaria at Rangamati. He suggested that in the interests of public health, the jungle should be cut down and the area opened up in order to reduce the incidence of malaria. In connection with this proposal, a malaria survey of the station and the neighbourhood was carried out by me and showed that the place was very malarious indeed. I had found the spleen index of children within the station to be 70 per cent. and it was as high as 90 per cent. in a village adjoining it. An anopheline survey of the station area and of the jungle showed that the jungle blamed on account of the malariousness of the

locality was perfectly innocuous as regards breeding of carrier species. On the other hand, within the station itself, there were innumerable breeding places in the form of seepages, streams and ponds which were breeding anophelines in large numbers, some of the species found there being well-known carriers; the species found breeding within the station were *A. karwari*, *A. fuliginosus*, *A. philippinensis* and *A. jamesi*. As a result of this investigation, it was recommended that instead of clearing the jungle, as suggested by the local medical officer, it would be advantageous not only to maintain the jungle intact, but even to extend it so as to cover all the valleys and thereby render the seepages and streams unfit for the breeding of carrier anophelines.

Mangrove jungles.—The Sunderban jungle area was investigated to determine the anophelines breeding within the jungle area and the influence of the jungle on the local malarial incidence. The Sunderbans is a maze of islands cut up by a network of tidal channels. Part of the area has been cleared of jungle and is under rice cultivation, while part of it is still covered by dense jungle. As most of the land is below spring-tide level, the area is subject to tidal flooding except where it is artificially protected by means of embankments as in parts of the opened up area.

The Sunderban jungle is a typical mangrove formation and differs from other jungles discussed previously both in the type of vegetation and its ecology. The flora is characteristic in that it consists largely of species which are viviparous, have stilt roots and pneumatophores as adaptations against the flooding of the land and the absence of aeration of the soil. The typical plants of this region are species of *Rhizophora*, *Ceriops*, *Kandelia*, *Bruguiera*, *Lumnitzera*, *Sonneratia*, *Carapa* and *Aegiceras*, besides *Avicennia officinalis*, *Acanthus ilicifolius* and the stemless palm *Nipa fruticans*.

It is only during exceptionally high spring-tides that the forest land is entirely submerged, but ordinarily it is only the lower regions of the forest that are covered by the flood. Within the Sunderban jungle, there are some shallow basins which hold up brackish water or saline water and which are not affected by the tides. These jungle swamps were investigated as well as the numerous small streams and channels within the forest. In none of these were any anophelines found although search was made for them.

The staff of the Forest Department posted in the interior of the Sunderban jungle stay in small floating flats anchored in creeks and channels. Their rooms were searched for adult anophelines and it was surprising to find that no anophelines could be found even after a careful search. A class of forest workmen known as the *Boali* live in the interior of the Sunderban forest in isolated huts erected on piles. A search was made in a large number of these huts for anophelines and not even a single anopheline could be found in any of them.

These results are in striking contrast to my experience in the cleared area. The cleared land which is under cultivation is protected from the

tides, which would destroy the crops, by means of embankments alongside every watercourse. Within the cleared and protected area, heavy breeding of *A. ludlowi* and *A. subpictus* often in association with *A. vagus* was observed in almost every place investigated. Breeding in these places is very heavy and the number of adult anophelines very great. The breeding places are the collections of brackish water which cannot drain into the watercourse which may be quite close, since such drainage is prevented by the embankments protecting the land against tidal flooding. The breeding being heavy and the number of breeding places being numerous, it is easy to explain the high incidence of adult anophelines in the Sunderban cleared area. One example may be given here to illustrate the prevalence of adult anophelines. Cattle are not able to stay out after sunset as they are so heavily pestered by the mosquitoes that they run into the cattle sheds for shelter early in the evening. These cattle sheds are so constructed as to be capable of protection against mosquitoes. They are of the closed type and are provided with a few small windows usually screened with mosquito gauze. In addition to such protection, almost every cattle shed is smoked in the evenings to drive away the mosquitoes. I have not seen any other part of Bengal where so much precaution is taken for the protection of live stock against mosquitoes. It should be superfluous to state that every person staying in this area, even the very poor, is provided with a mosquito curtain and the people take care to get under the curtain as early as possible after sunset. The contrast between such a condition and the entire immunity from anophelines observed within the jungle area is indeed most striking.

Whenever the writer, whilst engaged in the survey of the Sunderbans, halted for the night within the cleared area or close to it, the boat in which he was staying was invaded by hordes of anophelines, mostly *A. ludlowi* and *A. subpictus*. But when he halted for the night in the interior of the jungle area he found no evidence of any anophelines whatsoever. He took advantage of this experience and even when engaged in the survey of the cleared area, after finishing the day's survey work, he took the boat into the forest area towards the evening and halted for the night in the interior of the jungle and thus entirely avoided anophelines.

Although other species of *Anopheles* such as *A. sinensis*, *A. barbirostris*, *A. fuliginosus* and *A. varuna* are found in parts of the cleared area, *A. ludlowi*, *A. subpictus* and *A. vagus* are perhaps the most common species of the cleared area. There is no doubt that a considerable amount of malaria occurs in parts of the Sunderban cleared area and the malariousness is undoubtedly due to *A. ludlowi*.

In common with other jungle areas studied in Bengal, the mangrove jungle is not associated with any malaria prevalence. The present investigations show that the Sunderban jungles are remarkably free from anophelines and therefore perfectly healthy. Actually, the jungle

forms a definite protection against the breeding of *A. ludlowi*, the important carrier species of the region. The cleared areas, on the other hand, abound with this species and some parts are very malarious.

Discussion.—In every type of jungle land investigated in Bengal the anophelines found breeding within the jungle are entirely different from those found outside the jungle in the cleared area. While the species found inside the jungle are such as are not usually found concerned in the transmission of malaria, those that occur in the cleared area are largely species definitely incriminated in regard to the transmission of malaria. The jungles, as the present investigations show, are perfectly innocuous and actually form a definite protection against the breeding of harmful species of *Anopheles*. Immediately the jungle is cut down and the land exposed to sunshine the malaria transmitting species of *Anopheles* commence to breed in places where previously there was no breeding at all or the breeding was only of such of the species as are quite harmless to man.

The factors that account for the difference in the anopheline fauna are not yet clearly understood. The important factor that inhibits the breeding of the carrier anophelines seems to be the dense shade that prevails inside the jungle and the absence of sunlight in its effect on the flora of the water. But this is only a speculation as actually nothing is known definitely on this point. But certain observations seem to point to shade not being the only factor concerned in the inhibition of the open breeders inside the jungle. I have seen some areas in the interior of the Sukna forests where the water is exposed to the sun and conditions are apparently quite favourable for the open breeding species to establish themselves but yet they are not found there. A small clearing in the interior of a jungle far removed from human habitation and the exposure of the water to sunshine without the modification of the jungle conditions caused by the presence of human dwellings in the clearance so made, do not seem to make any difference in the anopheline fauna of the water. If the clearing be made and habitations are placed on the cleared land, the carrier species start breeding immediately. The breeding of the open breeder species thus seems to be connected with two factors—(a) the factor favourable for the larva, namely, the exposure of the water to sunshine and the consequent changes brought about in the fauna and flora of the water, and (b) the factor favourable for the adult mosquito in the availability of man and his domestic animals to feed on. A combination of these two factors seems to be necessary for the breeding of the open breeders. Either of these two factors by itself does not seem to be enough.

Considered from the biological point of view, these observations on the innocuousness, as regards malaria, of jungle seem to be perfectly natural. The transmitters of an entirely human parasite, such as the malaria parasites of man are, would ordinarily be species which are closely associated

with man. A species living away from man with very little chance of feeding on man to any appreciable degree would not be expected to be responsible for the transmission of the parasite. The species of *Anopheles* known to transmit malaria parasites in nature are all species closely associated with man or with his activities. Jungle anophelines which breed inside the jungle and normally feed on jungle animals have ordinarily very poor chances of obtaining human blood and much less chance of getting an infective feed of malaria. Even if it should chance that some of them get an infective feed, the chances of transmission of the parasites to a human being are very remote. It is impossible, therefore, to conceive of any jungle anophelines playing an appreciable part in the epidemiology of malaria.

The possibility of a reservoir of infection of human malaria existing in wild animals and serving to infect the jungle mosquitoes has been an obsession of the lay mind. It is often thought on the analogy of the reservoir of infection of trypanosomes in wild animal in Africa, that it is possible that wild animals in the jungle could similarly act as reservoirs from which jungle mosquitoes could get infected with malaria and transmit the infection to human beings living inside or close to jungle. Workers have from time to time attempted to ascertain if animals living inside forests harbour the human malaria parasites. All these attempts to ascertain if the human malaria parasites exist elsewhere than in man have been entirely negative. In India, Donovan (1920) investigated the blood parasites of monkeys, bats, squirrels and other animals of the forests in the submontane zone of the Nilgiri Hills and reported that the human malaria parasites are not found in any of the various animals that he investigated. There is little doubt at the present time that the three species of parasites causing malaria in man are entirely human parasites.

The investigations recorded in the present paper show not only that species of *Anopheles* which occur inside jungle in Bengal are harmless to man, but that jungle forms a definite protection against the breeding of species capable of transmitting malarial infection. It would be harmful, therefore, to effect any extensive deforestation without taking proper safeguards by way of *Anopheles* control, as by the opening up of forest land, breeding places which have been harmless hitherto are rendered favourable for the breeding of carrier anophelines. These observations point to a preservation of all existing jungle and to extension of jungle wherever feasible.

(*The Indian Journal of Medical Research*, July 1930)

DECORATIVE WOODS IN INDIA HOUSE.

Mr. H. Stainton Tireman has been good enough to contribute the following note on the timbers used in the new India House, the fine building recently erected in Aldwych for the offices of the High Commissioner for India, and which has just been opened by His Majesty the King.

A visit will well repay those interested in the use in this country of Empire timbers in general and Indian timbers in particular. The decorative woods of which India possesses so large a variety have been known for some time to a section of the trade, and India House, which has been decorated and furnished entirely in Indian woods, provides a unique opportunity for bringing them to the notice of the general public.

On entering the building the visitor will notice the front doors of Indian rosewood. The tree (*Dalbergia latifolia*) yielding this timber, which has long been known in Europe, is widely distributed throughout the Indian Peninsula.

On the ground floor will be found examples of Andaman padauk which has been used for doors, door frames and dados, and for a particularly fine counter in General Pay-room. This tree (*Pterocarpus dalbergioides*) is only found in the Andaman Islands; it has a somewhat vivid red colour, and the softer tone of the wood of the closely allied Burma padauk (*Pterocarpus macrocarpus*) may possibly be preferred. This has been used with striking effect for the panelling of the Library, the fine proportions of which show it off to great advantage. It has also been employed for the soffit to the balcony, and for the balustrade in the Exhibition Hall. Burma padauk occurs only in Burma. Both Burma and Andaman padauk have long been known in Europe and also in America, where the latter had some years ago a considerable vogue for the decoration of Pullman cars.

The High Commissioner's room and certain other rooms on the third floor are panelled and furnished in silver greywood—the name given to the darker coloured heartwood of *Terminalia bialata*. The fine figure and pleasing colour of this wood should make it a suitable substitute for the walnut so much in fashion to-day. *Terminalia bialata* occurs both in Burma and the Andamans, but it is at present exported only from the latter locality.

The Trade Commissioner's room on the same floor is panelled in white bombwe (*Terminalia procera*), a timber of the Andamans and Burma as yet little known in Europe.

One of the most remarkable instances of the use of Indian timber in this country is the large Committee-room on the first floor, the Indian laurel panels of which possess a unique figure. Laurel (*Terminalia tomentosa*) is one of the commonest trees of India and Burma, but, unfortunately, it occurs for the most part so far from the coast that the cost of shipping it is too great to permit of its competing to any great extent in the London market. On the same floor will be found the small Committee-room which is decorated with fine effect in kokko (*Albizia Lebbek*) a tree common in India, Burma and the Andamans.

White chuglam—the sapwood of *Terminalia bialata*—has been used for the less ornamental work on the upper floors, such as drawers in counters, doors, frames, skirtings, and cubicle screens. It is of a light grey colour,

easy to work and comparatively cheap, and should be suitable as a substitute for the cheaper forms of oak.

P'ynma (*Lagerstroemia hypoleuca*) from the Andamans has been used for the interior fittings of the book cases in the Library, and the backing of panels throughout has been done in toon (*Cedrela Toona*), a tree widely distributed throughout India and Burma.

The woods used for flooring are gurjan (*Dipterocarpus turbinatus*) and kokko. Gurjan in batten or block form has been used for all the corridors and for the majority of the rooms, while kokko in three-inch battens has been laid in the Library, and the silver grey and laurel rooms. Gurjan occurs in the Andamans and Burma; it is already well known in Europe. Kokko has not yet been used to any considerable extent.

The furniture of the building is in keeping with the panelling, and consists of rosewood, Andaman padauk, silver grey, laurel, kokko, and white chuglam. The rosewood furniture on the ground floor, the silver grey table in the High Commissioner's room, and the kokko table in the small Committee-room, are perhaps the most striking examples.

(*Empire Forestry Journal*, Vol. 2, No. 1, 1930).

SHOOTING IN NEW ZEALAND.

Sportsmen will be astir early on Thursday morning, when the 1930 shooting season will officially open one hour before sunrise. Several of the lakes, watercourses and other haunts of game in the Wellington Acclimatisation Society's district are the scene of busy preparation for opening day, and in some cases manuka shelters and camps have already been erected.

The Wellington acclimatisation district comprises 11 counties and extends 60 miles north of Taihape. It is bounded by the Wangaehu River on the north-west and the Waimata River, which is the boundary between Wellington and Hawke's Bay, on the east. The game which may be killed in the Wellington district is: cock pheasants, Californian and Australian quail, hares, grey duck, spoonbill duck, mallard duck, and black swan. The season for cock pheasants, quail, and hares will last three months. For other varieties of game is two months. A short open season for paradise duck has been declared from May 1 to May 7 in certain South Island acclimatisation districts. A close season is being observed this year for pukeko. Native pigeon is absolutely protected.

Both ducks and swans are reported to be in good numbers in their favourite haunts in the Wairarapa, but there are a number of lakelets over which the owners refuse to permit shooting, and with their strong instinct of self-preservation the birds seem to migrate to these protected areas as soon as the season commences. The Wairarapa Lake always attracts a number of sportsmen for its ducks.

The western side of the range does not offer so much protection to game as the Wairarapa, and better shooting should be obtained up through the Rangitikei district, where ducks and pheasants are reported to be plentiful. In the Shannon, Tokomaru, Wainui and upper parts of the Hutt Valley, pheasants and other game are more than holding their own. That is saying a good deal, because all game has plenty of enemies without the sportsman's gun.

Light rain would be of little or no concern to sportsmen, but in the event of a storm the birds divide into groups, making them difficult to obtain. A light wind would be an advantage to flight shooting for under such conditions the birds fly low.

(*The Dominion.*)

POPULARISING LAC CULTIVATION.

A provincial conference of Forest Officers was recently held at Ranchi under the presidentship of Mr. E. Benskin, Conservator of Forest. Mr. R. E. Russell, Revenue Secretary to Government, who delivered the opening address emphasised the advantages of holding such conferences, where officers got to know one another, discussed the difficulties which they had to meet and compared ideas. Above all, said Mr. Russell, such conference tended to create *esprit de corps* and anything which sought to attain this object ought to be encouraged.

He said that it was very encouraging to find that some measure of success had been attained in interesting landlords in forest conservancy, some of whom had already reserved their forests under the Indian Forest Act.

Many important subjects relating to forestry were discussed. The last conference was held in 1927 and since then considerable progress has been made in forest research in this province. Various less known timbers have been seasoned under the supervision of the Forest Department in a specially erected seasoning shed in Ranchi with a view to establishing a market for them. It was decided during the conference to sell these timbers as cheaply as possible so that people might be induced to buy them.

LAC CULTIVATION.

A good deal of interest has been taken of late in lac cultivation, as synthetic materials are threatening to oust shellac from the market. Hence the Forest Department is taking every step it can to encourage lac cultivation on sound lines in co-operation with the Indian Lac Research Institute, Namkum, Ranchi. The Director of this institute was especially invited to attend the conference in order that forest officers might hear of the latest developments in lac research. He read an extremely interesting paper and explained the results of researches carried on in the institute. The department has established a few lac plantations at suitable

places and in these plantations the latest methods of lac cultivation discovered at Nankum are applied in order to demonstrate them on a large scale. In this way it is hoped to improve the more or less primitive method of lac cultivation which is at present practised by the village cultivator. The lac industry is of vital importance to Bihar and Orissa and to the whole of India, as these provinces supply half the world's lac requirements.

(*The Pioneer.*)

DOMESTIC OCCURRENCES.

BIRTH.

A daughter was born to Mrs. Indira Rao, wife of Mr. S. R. Rao, I. F. S., in Madras, on 28th September, 1930.

INDIAN FORESTER.

DECEMBER 1930.

**SECOND INTERIM REPORT ON THE PROGRESS OF
INVESTIGATIONS INTO THE ORIGIN OF
TWISTED FIBRE IN PINUS
LONGIFOLIA, ROXB.**

BY H. G. CHAMPION, I.F.S., SILVICULTURIST, FOREST
RESEARCH INSTITUTE.

In the issue of the *Indian Forester* for January, 1927, (Vol. LIII, p. 18), I gave a summary account of the information collected as a result of inspections made of the special plantations in Almora district a few months earlier (September-October 1926.) The conclusion reached was a perfectly definite one, the sowings of seed of known parentage having demonstrated clearly that spirally twisted fibre in *chir* pine in Kumaon is inherited from the parents.

A further inspection has just been completed exactly four years after the last one, the plants now being mostly 13 and 14 seasons' old. It has now become possible to collect most of the data at breast height instead of near ground level, and so to bridge the gap that has hitherto existed between the seedling and the sapling and small pole stages. Accordingly, the main object of the special sowings has been to a large extent attained, as certain aspects of the problem may be considered as disposed of, though others still unsolved remain to prevent as yet a final

report and closure of the investigations. In place of such final report, the recently collected figures and the deductions which can be drawn from them will be briefly described in the following paragraphs:—

I. THE EXPERIMENTAL PLOTS.

- (i) *Maharpali*. 5,000', N. W. aspect on mica-schist, surrounding crop overmature, 100% twisted: 6 subplots, each $\frac{1}{4}$ acre. Walled. Sown 1917. Burnt 1921.
- (ii) *Khabdoli S.* 5,500', S. aspect, on gneissose schist, surrounding crop mature, about 10% twisted: 4 subplots, each $\frac{1}{4}$ acre. Walled. Sown 1917. Burnt 1921.
- (iii) *Sarna*. 4,000', sheltered E. aspect, clay soil over limestone, surrounding crop about 60% twisted. Roughly wire fenced. Sown 1919, 1920. Burnt 1921.
- (iv) *Kaligad*. 5,500', sheltered S. E. aspect on mica-schist, surrounding crop about 5% twisted. 3 subplots totalling $\frac{1}{2}$ acre; in a closed area. Sown 1920.

2. SEED USED.

- (i) *Imported Straight*. From Naini Tal and Haldwani divisions where twist, though not absent, is definitely exceptional—perhaps 2%.
- (ii) *Local Straight*. From Khabdoli South near the sowings, Majkot, and Kaligadh with about 10%, 10% and 5% of twisted trees, respectively.
- (iii) *Straight locality, Twisted trees*. From Khabdoli South as (ii) and (Kothiura).
- (iv) *Twisted locality, Straight trees*. From Maharpali and Chantaria with about 98% and 95% twist, respectively.
- (v) *Twisted locality, Twisted trees*. From Maharpali and Mauragaon, both with about 98% twist.

3. TREATMENT.

Seed was sown in broken lines along the contours. Unfortunately the general incendiarism in Kumaon in 1921 did not spare these enclosures, and fire swept through them all except Kaligadh. The older plants of Maharpali and Khabdoli survived in adequate numbers for continuance of the investigation (even extended to cover the effects of this almost normal form of injury), but two of the four younger plots in Sarna were ruined and the other two greatly reduced. Late heavy snowfall of 1923 bent many of the plants in Maharpali, the other plots being but slightly affected in this way.

At intervals (1919, 1920, 1921, 1923, 1926) the plants have been thinned out to give those retained adequate growing space and to provide material for examination. Generally, every plant removed has been measured for height, dominance, diameter, vigour, and twist at two to five defined heights. Examination of the roots was continued till the plants got too big. In 1930, the angle of the fibres was examined at $4\frac{1}{2}'$ — $5'$ and at $2\frac{1}{2}'$ on all stems removed in thinnings. At Sarna, it was recorded at $4\frac{1}{2}'$ — $5'$ for all the standing trees of the sowings, the number thinned being too low to be of use, and at $2\frac{1}{2}'$ on the natural regeneration which had replaced the annihilated sowings of two plots, too few having reached $5'$. In the early years, all natural regeneration was uprooted annually and except for an occasional natural seedling coming up in the prepared lines no complication can have occurred in this respect except in Sarna and to some extent in Kaligadh, where this very necessary operation was neglected after the first 3 or 4 years—and even here, the records of the numbers of surviving plants in 1923 has made it possible to reduce the maximum error to an unimportant magnitude.

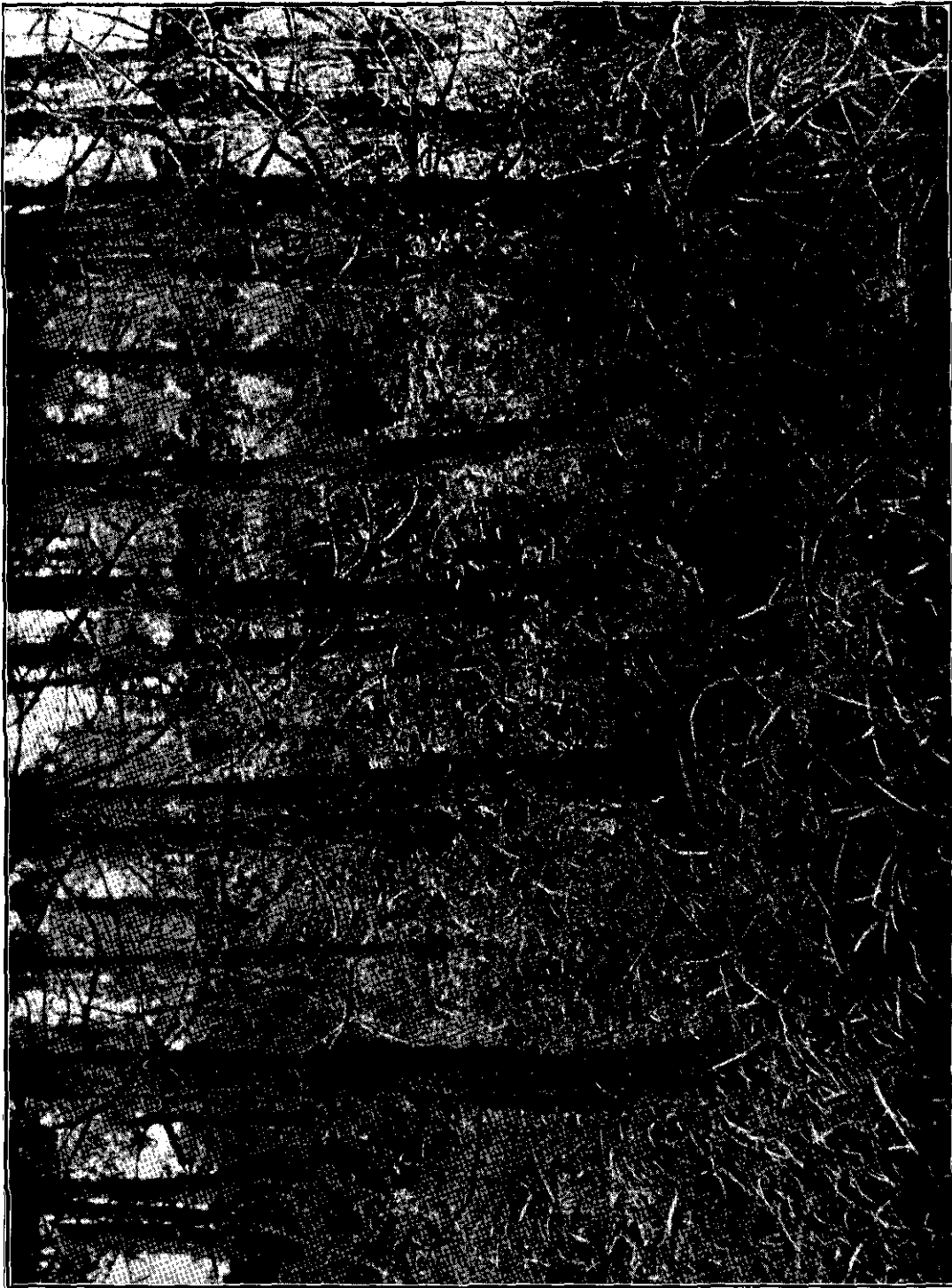
4. RECORDING.

It may be repeated that for all practical purposes the hypocotyl and short stem of the one-year-old seedling has been found in all cases to be entirely free from twist. The shoot of the season on older plants, if not completely free from the peculiarity, at least shews it in a very much less marked degree

than lower parts, and in a general way the fibre is less twisted higher up the stem in saplings and trees. Direct observation reveals the fact that in pronouncedly twisted crops, the intensity of the twist tends to increase with age, but in old age this tendency weakens and even changes in sign, at least in the upper parts of the stem where it may result in the development of right-handed twist. In straighter crops, such increase of twist is not usually apparent. Plants taken from the plantations in the earlier years were examined for twist in the root the old hypocotyledonary region (just above ground level), the base of the stem, and the upper stem, and compared with seedlings obtained from natural regeneration measured in the same way. As, however, all these parts are left in the stump in felling the grown trees, it was impossible to apply the deductions made from data collected on the seedlings, to the practical matter of timber production. In this last inspection, it was very generally possible to record data at breast height leaving several years growth above, and by taking measurements at lower levels also, to co-ordinate the results with the earlier data. Another small variation introduced was to record the actual angle of the fibres to the stem axis, in place of the former procedure, more convenient with the large numbers of small plants dealt with, of allotting to four arbitrary twist grades—these were $s = 0-5^\circ$; $\frac{1}{2} = 5^\circ-15^\circ$; $t = 15^\circ-25^\circ$; $2t = \text{over } 25^\circ$. Great accuracy was not aimed at in these measurements except where the angle approximated to the limiting figures of the grades.

5. SUMMARY OF 1930 DATA.

The stems removed for measurement were those which could be taken as a C/D grade thinning. As the seed was sown in lines which have been thinned out at intervals many dominants were available—a point which previous studies had shewn might be of importance, as crowded, dominated, or suppressed stems have tended to shew less twist than the co-dominant and pre-dominant stems. Some of the 1930 sets of data have, however, been worked up separately for dominants only and for all stems together, and so little difference is apparent that for present purposes, all measurements are included.



The 14-year-old plantation from seed from a straight-grained crop in Naini Tal division. Maharpali Plot I. G., W. Almora Division.
Photo by H. G. Champion, 30th September 1930.

For practical purposes, the most important figures may be taken to be the average angle of twist for the whole crop, and the percentage of stems in which the twist exceeds an angle seriously limiting the use of timber sawn from the trees—this limiting value having been taken at 7° throughout these investigations from the old specification for railway sleepers.

The following tables shew the average angle for each seed type in each locality (A), and the percentage of stems examined which had the fibres inclined at an angle greater than 7° at breast height (B). The figures in brackets in Table A shew the number of measurements on which the average is based; these numbers are inadequate in some cases and the derived figure is printed in italics to indicate this fact.

TABLE A.

Average angle of twist at breast height, 1930.

Seed Type.	LOCALITY AND YEAR OF SOWINGS, AND TWIST IN SURROUNDING CROP.			
	Kaligadh, 5% twisted, 1921.	Maharpali, 100% twisted, 1917.	Khabdoli, 10% twisted, 1917.	Sarna, 60% twisted, 1919, 1920.
1. Imported seed from straight trees in straight locality.	1 (35)	$2\frac{1}{2}$ (118)	0 (43)	...
2. Local seed from straight trees in straight locality.	$1\frac{1}{2}$ (30)	6 (63)	...	$4\frac{1}{2}$ (55)
3. Seed from straight trees in twisted locality.	...	7 (22)	...	9 (134)
4. Seed from twisted trees in straight locality.	...	11 (22)	...	...
5. Seed from twisted trees in twisted locality.	6 (32)	11 (63)	9 (20)	...
6. Natural regeneration in twisted locality.	...	10 (48)	...	$7\frac{1}{2}$ (129)

Note—1. In Kaligadh all trees were cut before examination.

2. In Sarna only, measurements were taken on all standing trees as well as on those removed as thinnings.

3. The last figure in the table is the mean of two values from adjoining plots, separately $7\frac{1}{2}$ and $7\frac{1}{2}$.

TABLE B.

Percentage of stems exceeding 7° twist at breast height.

Seed Type.	LOCALITY AND YEAR OF SOWINGS, AND TWIST IN SURROUNDING CROP.			
	Kaligadh, 5% twisted, 1921.	Maharpali, 100% twisted, 1917.	Khabdoli, 10% twisted, 1917.	Sarna, 60% twisted, 1919, 1920.
1. Imported seed from straight trees in straight locality.	0	1	0	...
2. Local seed from straight trees in straight locality.	3	25	...	22
3. Seed from straight trees in twisted locality.	...	36	...	45
4. Seed from twisted trees in straight locality.	...	59	...	...
5. Seed from twisted trees in twisted locality.	35	65	60	...
6. Natural regeneration in twisted locality.	...	72	...	45

Notes.—The last figure in the Table, 45, is the mean of two values from adjoining plots separately 40 and 49.

The second figure for Kaligadh is obtained with seed from a source with less twist (5%) than those used for the corresponding experiment for the other localities (10%).

6. DEDUCTIONS FROM 1930 RESULTS.

- (i) The chief conclusion which, it is ventured to suggest, is established beyond possible further doubt, is that the production of twisted fibre is a character which is inherited from one generation to the next, independently of any influence which soil and treatment may exert.
- (ii) It cannot be asserted that a 100% twisted parent crop will give a 100% twisted second rotation crop from natural regeneration, whether it is protected from adverse external influences or not, but it can be stated already that about two-thirds at least will be twisted



The 14-year-old plantation from seed from the surrounding badly twisted crop. Mahapali Plot I. F., W. Almora Division.
Photo by H. G. Champion, 28th September 1960.

- beyond serviceability for timber, even given that complete protection which experience has proved impossible in present practice. There are indications that the usual damage from trampling and burning may increase this percentage.
- (iii) The use of imported seed from a suitable source will give a crop at least to the sapling stage which is virtually free of twist, even in localities where the original crop is 100% twisted.
 - (iv) The use of seed from straight trees in localities in which the percentage of twist is moderate or low will similarly give crops in which the percentage of twisted stems will not exceed about 25%, and may perhaps be comparable with the parent crop.
 - (v) The use of seed from straight trees growing among a twisted crop is definitely preferable to that of seed from twisted parent trees growing among a predominantly straight crop, and may result in a new crop about 40% twisted as compared with 60% for the latter.
 - (vi) Closely comparable results are obtained in three of the four localities demonstrating independence of soil, underlying rock, and aspect.

The fact that the fourth locality, Kaligadh, has given definitely lower percentages of twisted stems with both types of seed used and is also the locality with the least twist in the existing crops is noteworthy and may be important, but unfortunately the figures have not the same weight as those from the other localities, being based on small numbers of measurements, obtaining no further support from data of other years, and the seed used being from supposedly comparable but actually different sources. At the same time, the figures shewn in the tables provide a striking confirmation of the *general* deductions (i), (iii), and (iv) above.

- (vii) The results agree throughout with those obtained in 1926 and 1923 and so derive additional reliability particularly where the numbers of trees now measured are small.
- (viii) The tentative conclusion is confirmed, which was reached on the data available up to 1921, that left-handed twist in *Pinus longifolia* in Kumaon, is of the

nature of a Mendelian dominant character which has originated independently in many localities, its extension being due to the long continued selection of the straighter trees for removal.

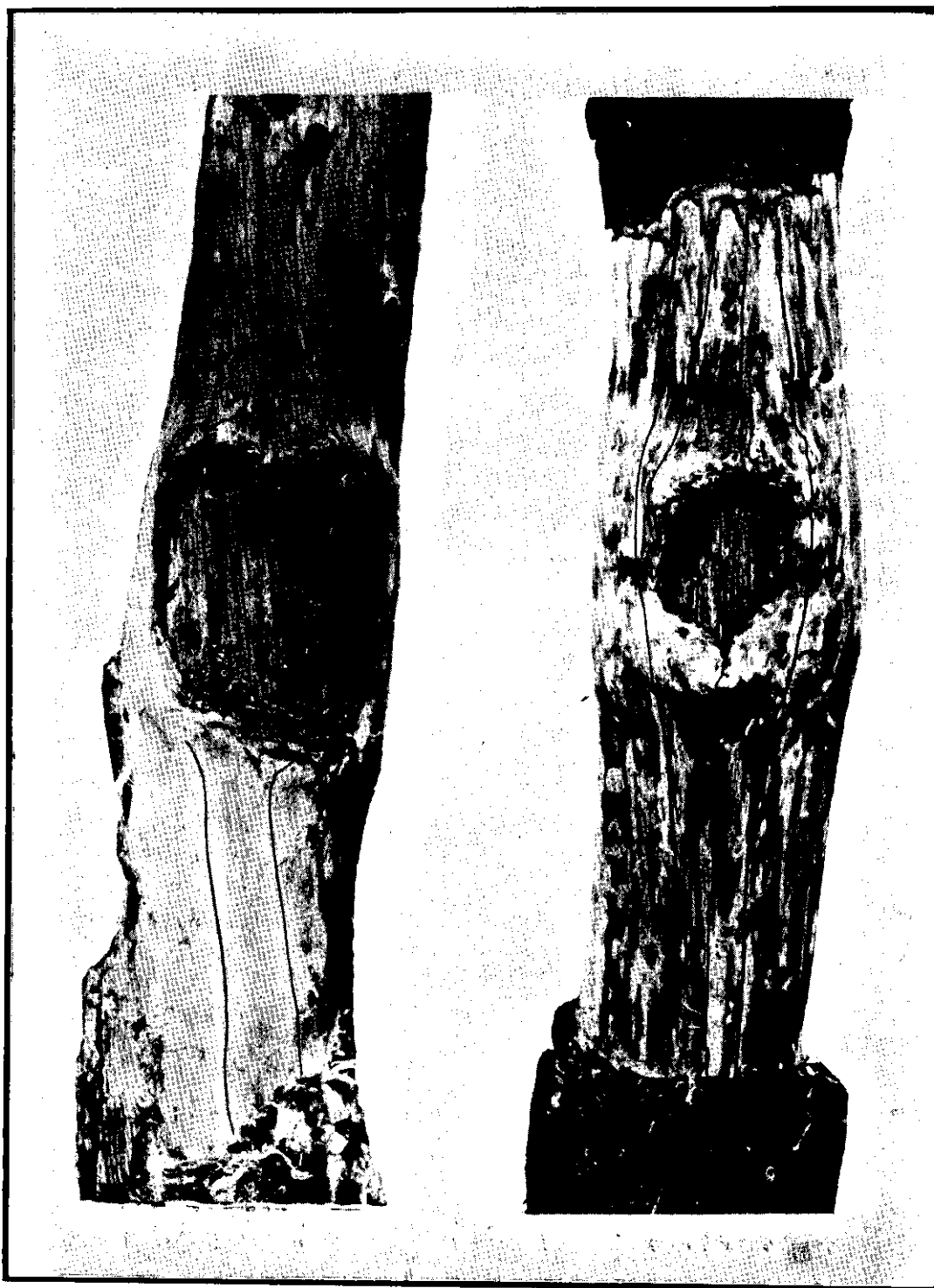
7. PRACTICAL APPLICATION OF THE RESULTS.

More confidently even than in 1926, it must be stressed that for all artificial regeneration work, careful selection of seed is a matter of utmost importance. It would be preferable to import from Naini Tal, Chakrata or other similar localities, all the seed required, and with the cheap motor transport now available this cannot be ruled out as totally impracticable. As, however, the bulk of the seed required must probably still be obtained locally, the need of strict insistence on the use of seed from straight trees is clear. The obvious source of seed is the main timber fellings, and if it is still found that the fellings are usually done too early in the season for the seed to be fertile (the valuable information that the cones can safely be collected as soon as they are full sized in December—*vide* S. H. Howard, Chir Seed Supply, For. Bull. No. 67—is still not generally utilised, it is believed), then, as has been found both necessary and practical in several other types of forest, the time of felling must be altered.

In making regeneration fellings in mature crops with a good proportion of straight trees, the straight trees must be selected as seed-bearers even at the sacrifice of good spacing. The offspring of the twisted trees will include twice as high a percentage of twisted stems as those of the straight trees.

In marking regeneration fellings in mature crops with a high proportion of twisted trees a very marked improvement may be looked for if the seed trees are mainly straight. The proportion twisted in the second rotation may be half that in the first.

The retention of unfit marked trees in shelterwood regeneration fellings on the score of cost of felling, is strongly condemned as contrary to all the tenets of good silviculture and in the face of the clear proofs now available of the results on the regeneration



Trees blazed nine years before, shewing the purely localised effect on the course of the fibres.

These trees have to be felled sooner or later, and it should emphatically be sooner.

The treatment of advance growth in areas brought under regeneration must be considered in the light of the foregoing paragraphs which shew what may be expected. It should be examined for twist in any case, and only retained if up to the standard probably attainable with the given parent crop.

Whilst a good deal more evidence is still required, the experience gained in the 14 years' course of these investigations all goes to indicate that the ordinary forms of injury to which *chir* regeneration is subjected, burning, browsing, trampling, etc. are not factors of first importance in the development of twisted fibre, though by causing distortion of the stem they may exaggerate the defect already present.

8. OTHER NOTES.

- (i) *Wire binding experiments.*—Twenty young trees in a straight locality (Kaligadh C. 2), and 20 in a twisted locality (Chilianao C. 1) were tightly bound with wire in 1921 at a height of 2' from the ground with a view to seeing whether the resultant constriction and swelling above the wire would result in any marked development of twist on an analogy with the strongly swollen bases of intensely twisted mature trees. Samples were barked and no difference whatever was discernible in the direction of the fibres above and below the constriction either for definitely twisted (23°) or almost straight grain. The swelling in the wood was, however, not great, and observations will be continued.
- (ii) *Partial girdling.*—In 1921, also, 20 young trees in each of the same two localities were partially girdled at 1½' from the ground, removing $\frac{3}{4}$ of the circumference, the retained $\frac{1}{4}$ being in the form of a narrow strip of bark on each side; the wound was thus symmetrical. Considerable callus formation has ensued and there was some further injury from controlled burning in 1929. Samples were barked and examined, the

initial angle of the fibre being clearly apparent on the unoccluded blazes. Here again, though marked distortion is apparent where the callus formation had been most active, a short distance above and below the blazes the angle is found to agree precisely with the original. Thus 9 years has not been enough to shew any measurable development of twist consequent on this drastic form of injury.

- (iii) *Spiral contortion of the axis.*—The Maharpali sowings suffered to a considerable extent from snow in 1923. Ordinarily, the result is the development of a sabre-shaped basal portion of the stem as it straightens itself after being bent by the pressure of the snow. It was noticed that many stems in place of this simple bend shewed definite spiral contortion. (See Ind. For. 1927, Plate IV, p. 21.)

Although exceptions occur in which such spiral stems are not pronouncedly twisted fibred, a close connection between the development of spiral axis and twisted fibre is apparent from the following figures comparing the proportion of non-straight stems which are more or less spirally contorted, with the average angle of twist at 2½ feet on the different plots.

Average Twist	...	3	6½	9	12	15	13
Percentage of spirally contorted stems	...	11	17	29	69	75	76

Thus the presence of twisted fibre increases the importance of the depreciation in timber value due to snow pressure.

FOREST AND STREAM FLOW.

BY E. BENSKIN, I.F.S.

(Continued from pp. 440—42 of the "*Indian Forester*," Vol. LVI,
October 1930.)

In the October number of the *Indian Forester* certain information was given regarding the behaviour of soil moisture in the case of forest and denuded lands. During the past monsoon it has been possible to carry these investigations further, although I have not had the time to treat the subject with the same

amount of detail as would be expected from those whose vocation is research. My previous observations had shown that the amount of leaf litter which annually falls in the case of first quality sal forests, is capable of absorbing slightly less than 0.03 inches of rain, and that the theory that forests control stream flow by means of the absorbing power of the litter certainly did not apply to Chota Nagpur. My further investigations have been directed to determining the effect of forests on moisture retention.

Two areas, one under forest and one denuded, both as nearly as possible similar, were selected and a series of moisture and other analyses made. In some respects the forest area was unsatisfactory for comparative purposes, being of very poor quality, without underwood and of very small size. Samples of soil were taken at regular intervals of 9" down to 27" and the percentage of moisture was calculated by the usual method of heating about 20 grms. of soil in a water oven for 24 hours at 95C. Rainfall records maintained at the Lac Research Institute, distant about four miles from the experiment, were also examined.

Forest area.

<i>Situation</i>	...	Between Mahilong and Silwai, south of the Ranchi-Purulia road.
<i>Area</i>	...	About 5 acres.
<i>Stock</i>	...	128 stems per acre (average). Diameter 1'-1, (average).
<i>Undergrowth</i>	..	Nil or very sparse.
<i>Soil</i>	...	Light loam, depth 3'-6", resting on a quartz pebble bed 1'-6" deep, below which rock is met with. Sticky point 18.9 per cent. Sand 37.9 per cent. Organic matter 3.2 per cent. Index of texture 11.3 per cent.
<i>Aspect</i>	...	North-west.
<i>Slope</i>	...	Slight.
<i>Miscellaneous</i>	...	The area is open to grazing but owing to the entire absence of grass is not resorted to.

Denuded land.

<i>Situation</i>	...	South of the Ranchi-Purulia road near the junction of the Horhap Forest road,
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- Area** ... The land has the appearance of old, and abandoned upland cultivation, is generally typical of denuded land in Chota Nagpur and is unfit for permanent cultivation. The land is almost bare except for scattered vegetation such as *Eragrostis tenella*, *Perotis latifolia*, *Sida rhombifolia*, *Vernonia cinerea*, *Ionium dsuffruticosum*.
- Soil** ... Light loam, average depth 2'-9", overlying a layer of quartz pebbles, below which rock is met with. Sticky point 19.5 per cent. (average). Sand 33.7 per cent. Organic matter 4.1 per cent. (average). Index of texture 13.3 per cent.
- Aspect** ... North-west.
- Slope** ... Slight.
- Miscellaneous** ... The area is open to grazing but owing to the almost entire absence of grass is not resorted to.

The monsoon broke on the 15th of June with a rainfall of 1.43" and ended on the 26th September with a burst of 3.97". The following table gives the subsequent soil moisture variations:—

Date	RAINFALL (Inches.)		FORE-T SOIL. MOISTURE CON- TENT %.		DENUDED SOIL MOISTURE CON- TENT %.		REMARKS.
	Previous four days.	Since 1st June.	Average 0'- 27".	At 9".	Average 0'- 27".	At 9".	
14-6-30	<i>Nil</i>	0.62	0.62	0.42	10.82	0.66	
10-8-30	2.52	36.32	14.85	14.4	15.35	14.3	
15-8-30	1.86	40.97	11.8	12.6	15.35	14.69	
6-9-30	0.41	45.35	11.66	9.74	12.99	16.14	
26-9-30*	2.20	53.34*	12.09	13.37	13.62	17.6	*3.97" fell on 26-9-30 but has been recorded with the reading of 27-9-30.
19-10-30.	<i>Nil</i>	57.31	9.1	7.5	11.05	10.1	

NOTE 1.—1 % of moisture over a depth of 27 inches is the equivalent of approximately .35 inches of rain in both cases.

From the above figures it is evident that, in spite of the canopy, the forest soil remained drier than the denuded land throughout the monsoon and especially was this the case on the surface. Considering the close resemblance of the two soils I feel that the difference is largely due to the loss of soil moisture by transpiration. A certain amount of moisture in the case of the forest may not reach the soil on account of the canopy but that is probably negligible. It would, therefore, seem that a soil covered with vegetation, by being depleted of moisture through transpiration, has room for further absorption and is consequently slower in reaching saturation or flooding point than is the case with a bare soil. For instance, on the 26th September, 1930, there was unusually heavy rainfall, 3.97" falling within a few hours. This rainfall caused exceptionally high flood levels in the upper waters of the Subarnarekha. Moisture readings taken five hours after the cessation of rains, showed that while the top 9" of soil in the case of the denuded land was near saturation point the forest soil reading showed a markedly lower moisture content.

Little, if any, difference was discerned between the rate or degree of moisture penetration in the case of forests and denuded land.

Other experiments carried out indicate that grass, if left ungrazed and uncut during the monsoon, has an effect on stream flow considerably greater than forests.

Floods have become an increasingly serious problem in India and there is no doubt that they originate largely from the wide areas of denuded, overgrazed and exhausted lands. Enormous areas have been, and are being, unwisely disforested and shifting cultivation still flourishes in many places. To reafforest any large portion of these denuded areas would be well nigh impossible and enormously expensive. I think, therefore, that the improvement of grazing grounds and the formation of fodder reserves offer a practical remedy for floods. The condition of the cattle and pastures of India is nothing short of deplorable and it is probable that a national scheme of improvement would receive the support of the Indian leaders.

REGENERATING A KIKAR (*ACACIA ARABICA*) CROP IN MULTAN DIVISION OF THE PUNJAB.

BY RAM NATH KASHYAP, P.F.S.

Jhalarian forest situated on the bank of Chenab river in the Multan Forest Division contained a plot of about 400 acres of *kikar* (*Acacia arabica*) crop, mostly mature. Except in glades, which had been previously leased out for cultivation of agricultural crops, there was no regeneration of the species. The area was open to grazing, and is almost annually inundated from the river in the month of July or August.

2. During the year 1926-27 the area was closed to grazing and in winter very heavy fellings were made, removing all the trees except young promising poles. By the end of March 1927, the area was cleared of all the wood and it looked like a coppiced area with standards. In the last week of May, when *kikar* seed pods were ready, the area was thrown open to grazing by cattle and goats for a week free of payment, and the animals were fed on the *kikar* pods artificially lopped for the purpose. During the whole day the animals were kept on the area and Mehta Ishwar Das, Forest Ranger, remained on spot for the week. Then the area was strictly closed to grazing of all kinds. There was on the ground plenty of droppings of cattle and goats containing *kikar* seed. In the first week of August, the area got flooded from the river and after that the seed germinated profusely and the area was completely regenerated. It will be too much to say that all *kikar* crops can be regenerated in this manner, but it should be possible to do so where similar conditions obtain.

NOTES ON A CASE OF "VOLVULUS ET TORSIO INTESTINI" IN AN ELEPHANT.

BY S. C. SEN GUPTA, VETERINARY OFFICER, FOREST
DEPARTMENT, ANDAMANS.

My plea for recording the following notes is that it is one of the rare cases met with amongst elephants, and may be of interest to the profession. The only recorded, one as far as I can gather, is that by Johne. (q. v. pp. 287 Hutyra and Marek's Special

Pathology and Therapeutics of the Diseases of Domestic Animals 3rd edition.)

The subject was a cow elephant (named "Meerut") aged about 53 years, who had worked in the Andamans Forest Department for a period of 28 years in timber extraction. She was one of the best and well acclimated animals, and was rarely known to be sick.

On the 29th October, 1929, I received information to the effect that this elephant showed symptoms of colic. I went to the spot at about 5 p.m. the same day and had a look at her. She appeared to be standing at ease except for an occasional yawning and turning sideways to relax the abdominal muscles. I diagnosed it to be a case of colic and tried to induce her to take some carminatives. But she would not take anything—not even the paddy which she was very fond of. She went furious and would not allow her *mahaut* or any one else to approach her. She was, however, secured and a manual examination per rectum was made, which revealed that it was completely empty. Nevertheless with some difficulty an enema of soap and warm water with turpentine was administered; but nothing came out beyond the injected fluid with traces of blood. The elephant did not show any signs of relief.

Urine was dribbling: the abdomen was later found to be distinctly distended with tympany. At this stage the animal was getting restless and was assuming different postures such as sitting restless at times, instantly getting up, lowering her head and throwing all her weight on to the trunk which was fixed to the ground.

About three hours later, while an attempt was made to secure the animal for a second enema, she broke loose and decamped into the forest. It was a pitch dark night and after a hunt with the help of a gas light we managed to spot her. Her condition then was that she would lie down every few yards she went. She was noticed attempting to evacuate her bowels but without success. She was now so furious that while bringing her back from the jungle she threw off her *mahaut* and again bolted. It was impossible to find her any more that night.

On the following morning (30th October, 1929) she was brought in with her abdomen fully distended. It was evident from the condition then, that she must have been suffering terribly during the whole of the previous night. She would not sit or lie down now, as she was doing on the day previous.

She was secured with difficulty and at great personal risk another enema and internal antispasmodics were administered. In spite of her swallowing the medicines and taking the enema successfully, the result was disappointing; a manual examination per rectum revealed that it was as empty as before. This led me to conclude that it must be a case of volvulus or intus susception of the intestines somewhere higher up.

After the above operations I freed the animal so that she might ease herself as much as she could. It must be remembered that the above processes turned this usually docile animal into a savage one, making it unapproachable. Also the time taken was about 3 to 4 hours.

When she was freed she inclined herself on her left on a slope resting her whole body on it. A few seconds after, she got up, walked a few paces and stopped for a while. She repeated this operation once or twice until finally she came to a dead stop resting her head on the ground and throwing the whole weight of the body on it. Thus she remained for a while, gave a grunt and expired, the body remaining in the same position, even after death.

An autopsy held immediately after revealed the following facts:—

That portion of the small intestines, *viz.*, the terminal end of the jejunum and the proximal end of the ileum, was found to be the seat of the volvulus with partial torsion. On opening this up, the entire lumen of the intestines was found to be in a state of acute congestion. The rest of the intestines were more or less normal though highly distended with gas. The tinge of blood noticed in the outflow of the enema was found to be due to the congestion of that portion of the rectum lying anterior to the pelvic wall. This portion of the rectum was not only

distended with gas but was also deflected by the accumulation of dung. The enemas administered were ineffective simply because the injected fluid could not pass beyond this point of deflection. The non-expulsion of the dung and gas which were in the portion of the intestines anterior to the pelvic bone is explained by the stasis and subsequent paresis of the intestines beyond the portion affected by the volvulus. The contents of the stomach and intestines were in a fluid state.

EXTRACTS FROM:—OBSERVATIONS ON THE EXPEDIENCY OF SHIPBUILDING AT BOMBAY FOR THE SERVICE OF HIS MAJESTY, AND OF THE EAST INDIA COMPANY.

BY WILLIAM TAYLOR MONEY

Late Superintendent of the Marine at Bombay, London, 1811.

[A typewritten copy of this Note published in 1811 was sent to us by Mr. H. J. C. Millett, Deputy Conservator of Forests, Bombay.—HON. ED.]

“ The British Navy has so long been the pride of our country that an interest in every thing, connected with *its prosperity*, may justly be regarded as the natural feeling of every British heart.

“ Any means which can be devised, to preserve and perpetuate this great bulwark, must not only be a benefit to England, but to every nation disposed to contend for its independence.

“ The annihilation of the power of Tippoo Sultan, by the conquest and partition of Mysore, left at the disposal of the British Government, extensive regions, abounding with timber better adapted than any other to the purposes of naval architecture.

“ The extent of these resources was, till lately, unknown—the forests of Malabar having served only for the *marine of the East India Company*, and for the country shipping of India—and the national and natural predilection for British oak might still oppose an irresistible obstacle to the use of Indian teak, were it not unhappily a fact too well established, that the excessive consumption of oak, by the great increase of British shipping,

military and mercantile, has created such an alarming scarcity of that valuable timber, that, if some substitute be not employed, the materials of the British navy will, at no distant period, be exhausted.

"This fact, however, having been denied in a recent publication, it becomes necessary to establish it upon authority sufficient to set the question for ever at rest—for it must, without hesitation be admitted, that if the oak of England be the wood best adapted for shipbuilding and no real scarcity exist, it would be injustice to the interests of very respectable and valuable bodies of men, the shipbuilders, timber merchants, and landed proprietors, to urge the substitution of any foreign wood. Those who contend for foreign timber are, therefore, at issue with the authors of this recent publication, as to the existence or non-existence of a scarcity of oak for shipbuilding in England; and if so alarming an evil shall be found to prevail, all individual interests must sink in the magnitude of this national concern.

"In a memorial from the shipbuilders in the port of London, to the Committee of the Privy Council for the affairs of Trade and Plantation, they state that "They are induced to think, from recent accounts, and the knowledge now possessed by the public, in consequence of the enquiries which very generally took place on the discussion of this subject, a few years since, that there is not any real scarcity of oak timber in Great Britain, and that a reference to the present state of the ships of war now building in the private yards throughout the kingdom, which exceeds three times the number of King's ships, that were building at one time before, in them, the danger of scarcity will appear merely ideal....

"The Commissioners of the Navy represented the evil to the Royal Society, requesting them to suggest a remedy, and Mr. Evelyn, a member of that institution, declared, in his publications, that the devastation was so extensive that nothing but an universal planting over the kingdom could supply an effectual remedy.

"The effect of his writings was a general plantation throughout the country, and a distinguished statesman* to whom the navy

*The late Lord Melville.

is under peculiar obligations, in remarking on this fact, has observed, that as it is allowed that oak trees fit for the navy are from 80 to 150 years old, according to the quality of the soil, it is obvious that the vast quantities of great timber which have supplied the consumption of the present reign, were chiefly produced by that spirit of planting which the writings of Evelyn universally excited.....

" England is described, in the earliest accounts, as having been covered with wood, and in the reign of William, the Conqueror, oak was so abundant as to be valued, not by the quantity of timber or of what could be annually felled, but by the number of swine which the acorns could maintain.

" The first general attack upon the oak is represented as having been made by Henry the VIII, when he seized upon the monasteries, and disposed of the timber.

" This measure, the Commissioners state, was followed by a continued consumption of oak timber, not only in the gradual extension of commerce, and of the royal navy, but in house building, for which, in the 16th and 17th centuries, oak was principally used.

" In subsequent reigns, but particularly in the reign of James the I, a considerable revenue was derived to that needy monarch from the sale of timber, which at that time was 10s. a load, for oak fit for the navy, being not one-twelfth of what is now paid.

" The Commissioners have subjoined a very curious note to their report, to shew that the advance in the price of timber has no connection with the value of money since that time.

" A shilling contained the same quantity of silver in the time of James the I, as it does now, and the price of the best wheat* at Windsor market for 51 years, from 1595 to 1646, was £2-0s.-3d., the quarter, which was higher than the average price for 51 years from 1741 to 1792.

" Does not this incontestibly prove that very opposite causes operate upon the prices of wheat and of timber—that the increase

* The soil fittest for oak is also that best adapted for wheat.

of agriculture keeps the one comparatively low, and the consequent decrease of wood, with an increased demand, raises the price of the other exorbitantly high.....

"Enough has been herequoted, from the best authorities, to shew, that the scarcity of oak timber for shipbuilding is not an imaginary but a real evil, of alarming extent, and that it is not of a temporary but of a permanent nature—the decrease in the quantity of timber and the increase in the demand for it, having been gradual for a length of time—indeed so great has the scarcity become, that it was lately declared, in the House of Commons, without contradiction, that there was not timber enough at Plymouth to build one ship of the line..... •

"The most direct, simple and efficient mode of applying a remedy to the existing evil, is to spare the oak, and employ other woods for those purposes to which oak has heretofore been appropriated, particularly to shipbuilding.

"The consideration then naturally arises, if there be other woods in England, calculated for that important object.

"Of all the woods in Europe, it has been ascertained that next to British oak, and superior to foreign oak, the larch may be ranked.

"At Archangel, all the ships for the Russian navy, are built of larch, and it was formerly used for the same purpose at Naples and Venice. It has been found to resist the worm, and requires neither pitch nor paint to preserve it.

"These are great qualities, and were there abundance of this valuable wood in England, it would doubtless be wise to apply it as a substitute for oak in shipbuilding—but the quantity is known to be totally inadequate to the demand that would be made for it.

"It may, however, be brought in aid of the general measure recommended, of sparing the oak at the present time, by substituting larch in machinery of various kinds, in lighters, barges, and boats-piers, bridges, wharfs, locks and sluices, in wheelwrights and coopers works, park pales, posts and rails, and generally in house-building.

"Of the other woods in England some experiments have been made during this war, particularly of fir in shipbuilding—but they were intended only as partial experiments for temporary purposes; for the known qualities of fir forbid any reliance on its durability.

"There being then in England no wood, which approaches the oak in fitness for shipbuilding, we must look out of England for those supplies which her exhausted forests cannot afford—and where should we so naturally direct our attention as to her own dominions. It has not, however, been till of late that this natural preference has been given—very large supplies have been drawn from the north of Europe. But necessity has at length compelled us to do that which a regard for our own colonial interest should long ago have taught us to adopt—and we have had recourse to our American possessions for supplies of oak timber inferior, no doubt, in every requisite quality, to the oak of England, but superior to the same wood produced on the continent of Europe.

"Upon the same ground of independence of foreign aid, that we seek supplies from our transatlantic dominions, it is incumbent on us, especially in a time of need, to render the vast resources of our possessions in the East subservient to the wants of the mother country.

"The teak of Western India may be obtained in abundance for all the purposes of naval architecture for which it is known to be eminently adapted.

"There is, however, one, and a very substantial objection to an importation of it into England, for the purpose of building at home, and that is furnished by the very heavy expense of freight on so long a voyage, which would render the cost of a ship dearer than the circumstances of the country could justify.

"The question then resolves itself into this proposition—shall we forego all the benefit of our Indian forests, by a determination to build no where but in England, in compliment to the interests of individuals, however respectable; or shall we avail ourselves of these valuable resources by the application of them to shipbuilding in India?

"It has been asserted, that an encouragement to shipbuilding in India must tend to the injury of several of the establishments in the port of London, which have been reared at a great expense to individuals, and which in time of war have rendered important service to the State, by the numerous ships which they have built and repaired for the navy—that the loss to those who have embarked extensive capitals in these undertakings must be ruinous.

"Were these to be the results of the measure now proposed, they could not be sufficiently deplored; but even then they should be regarded as the lesser, in a choice of evils, as necessary sacrifices of individual interests to the public weal.

"At Penang and Calcutta, the ships are built of teak, which is not the produce of British territories; but Bombay may put forth its equal claim which Canada or any other dominion of the Crown of England, to the privilege which the North American States enjoyed, before their separation from the mother country of employing their own ships in the commerce of Great Britain—and it will hardly be contended that, while ships built of Canadian oak, and in the Gulf of St. Lawrence, can, under the sanction of a plantation register, trade under the British flag to the ports of England, the East India Company should be deprived of the power of engaging in their own trade, ships built at Bombay, of a superior wood, the produce of Malabar.

"By building at Bombay, to which my present argument is confined, the supply of shipping to the navy and to the East India Company cannot be so immediate, or so extensive, as to produce the calamitous consequences predicted by the memorialists, while the aid afforded to those great maritime interests must be considerable.

"The demand on the builders on the river Thames for a renewal of tonnage to these important services, must very gradually decrease—there will, therefore, be many years for preparation to meet the loss of building for the East India Company, and to seek employment for their shipwrights in other branches of the trade of the port of London, while the number of ships which they will have to construct for the navy will probably not be reduced below

the standard at which they were accustomed to contemplate it a few years ago.

"There will, therefore, still remain no inconsiderable share of business to the builders on the river Thames—perhaps sufficient to employ all the hands whom they include in their regular establishment.

"Hitherto it has been argued, on the ground of ascertained scarcity of oak to an alarming extent, that the resources of British India should be rendered subservient to the wants of England, and, for the reasons assigned, that they should be applied to that purpose at the port of Bombay.

• "The mode and extent of the application intended to be proposed, I now proceed to state, and as material to the proposition, it is necessary to consider the comparative qualities of oak and teak, or, as it has been well named by an eminent botanist the '*Quercus indicus*'.

"It appears to be universally admitted, and certainly it is practically so, that, of the various metals in common use, iron must ever form a component part of shipbuilding—of what consequence then must it be, that the two substances, wood and iron, which are to have so close a connection, should be free from any mutually destructive qualities. Of what importance it would be, that either one or the other should possess a preservative property which should render their union more permanent.

"It is a lamentable fact that the oak, the pride and the stay of our country, contains a powerful lignic acid, that corrodes and consumes the very metal which is employed to unite and secure it. In the various forms into which it is converted for the purposes of naval architecture, and therefore to discover some means of protecting iron from the corrosive action of the acid of oak—and thus to increase the durability of ships, has long been a desideratum with nautical men, and has long, but unavailingly, engaged the researches of science.

"It is a circumstance too well authenticated to need proof that teak abounds with oleaginous particles, the best and certain defence of iron from corrosion by the action of acids.

"Here then are two descriptions of wood, both calculated by many valuable properties, for the purpose of naval architecture but the one possessing a menstrum that, by gradually destroying the metal which connects the various parts of a ship loosens its frame and shortens the period of its existence—and the other a preservative which strengthens the union of wood and iron, and quadruples the duration of the noblest work of human ingenuity.

"Innumerable instances may be furnished in support of these facts, but one under the authority of an officer whose professional attainments adorn the service to which he belongs may perhaps be sufficient.

"Captain Wainwright, of H. M. Ship *La Chiffonne*, in a letter written on board that ship in Bombay harbour, on the 29th March, 1810, observed to the author—"It is impossible to give a more substantial proof of the superiority of the teak wood over that of any other that I have seen used in building ships than the following, which was related to me by Mr. Henderson, the carpenter":—

"The shipwrights who are at work on board *La Chiffonne* cut out of the wales a piece of teak plank, which had been placed to stop a short hole, at least eight years ago. The iron bolt which secured this piece of wood was perfectly good in the part which remained in the teak, and the part which had been fixed in the oak timber totally corroded."

"Oak is well known to be particularly obnoxious to the worm whose devastations on ship's bottoms have sometimes been productive of fatal consequences, while teak, guarded by its native oil, is never penetrated by this destructive vermin.

"It is related of a shipbuilder, who had examined worm eaten ships, that he had remarked that the worm never eat within the seams where oil had been introduced with the caulking chisel—that whalers which have been attacked by the worm are never touched where the whale had lain in contact with the vessel till it was cut up—and that a plank lying under water, at a mill, had been renewed annually on account of the destruction

of the worm, till at length one was put down which had been for some other purpose impregnated with oil, and it lasted for seven years.

“The author has also known the efficacy of oil in destroying worm, and particularly in a recent instance at Bombay. This destructive creature had made its way into the Company's mast house, and destroyed a considerable number of valuable fir spars. Those which had escaped the ravages of the worm were rubbed over with oil, and preserved from its further progress—and it was observed during the progress of applying the oil, and that whenever it came into contact with a worm, instantaneous death ensued.

“But the frequent application of such a remedy, to large bodies, must be extremely expensive, and in many situations and circumstances impracticable. How invaluable then must that timber be, which combines, with every good property possessed by the oak, a sure preservative of iron from corrosion and inherent defence against the attacks of this destructive worm.

“It has been urged as an objection to teak, that it is much heavier than oak—that the ships constructed with it draw more water and that the superior weight in the upper works render them more crank. This objection is founded in error. The advantage I have ascertained by many experiments to be in favour of teak from Malabar, which upon an average, weighs one quarter less than oak; while the weight of teak from the forests to the northward of this port, and of oak, has been found to be nearly the same.

“It has also been objected to the use of teak in the construction of men of war, that it is particularly disposed to splinter. Those who have had most experience of this invaluable wood have always denied the solidity of this objection; but as it has, notwithstanding been repeated, and particularly since the Board of Admiralty most wisely adopted the measure of building men of war at Bombay, it must be satisfactory to every impartial judgment to receive evidence of the truth from an authority

which it cannot fail to respect. It is, therefore, with particular pleasure that the author is enabled to give the opinion of the distinguished officer who commanded the expedition against the Isle of France.

"In a letter to the author, written on board *L'Africaine*, at sea, General Abercrombie observed, "I can now vouch that the effect of shot upon teak is far less dangerous than upon oak—on board the Ceylon there were very few men wounded by splinters".

From the great cause of excellence in the teak over the oak, by the possession of an oil instead of an acid, there result the most important consequences in the durability of ships built of this wood.

"The answers given to the enquiries of the Commissioners of Land Revenue, as stated in their report to Parliament, respecting the average duration of ships of war, fix the period for those built in the royal yards, at fifteen years, and for those constructed in the private yards, at ten years.

"The same enquiries having been made as to the duration of the shipping of the East India Company, twelve or fourteen years appear to be the extent of their service.

"The Commissioners observe, upon this information, that every addition to the duration of ships being obviously a proportional saving of timber, if means could be devised to make ships of war last 18 years, one third part of the present consumption of the timber for the navy would be saved.

"Had these Commissioners, to whose long, patient, and laborious researches the country is essentially indebted, been aware of the durability of teak, when they attached so much importance to the devisal of means for continuing the existence of men of war to the length of 18 years, they could not have failed to have urged the use of it with all the weight of their experience and authority.

"A vertical sun, which rends and contracts European wood, produces no injurious effect upon teak, which exposed without defence to the greatest heat, or to all the violence of the rainy monsoon, exhibits no indication of injury or decay.

"Many of the upright timbers to the old docks, for securing stages in the repairs of ships, have stood more than 40 years without a coat of paint or tar for their protection, and yet are as perfect as when first erected.

"A piece was taken out of a gate of one of Tippoo's forts in Canara, which had been exposed to every change of weather for more than half a century, and when brought to Bombay was ascertained to be unimpaired, with nails which had secured it quite free from corrosion or rust, and as sound as when first driven.

"The notoriety of the durable quality of teak, and especially in climes to which it is indigenous—and the experience which has been had, in some instances almost fatal, of tropical heat accelerating the decay of oak, forcibly suggest the policy, the expediency and the humanity of having all the men of war employed in the East or the West Indies, and all the ships in the East India Company's service, constructed of teak.

"It would be good policy, inasmuch as a great expense would be saved—and this, when we reflect on the magnitude of the present scale of our public expenditure, is a consideration of no little importance. An idea may be formed of the extent of the saving from the following calculation. It is presumed that the East and the West Indies, the Cape of Good Hope and the Brazils, will require, with the necessary reliefs, twenty sail of the line, and fifty frigates :—

Twenty sail of the line, each ship averaging 2,000 tons, at £36 per ton, will cost in England £1,440,000, and if three times renewed in 50 years, the expense will be ...	£5,760,000
Twenty sail of the line of the same tonnage, not requiring to be renewed for 50 years, will at Bombay cost at £30 per ton ...	£1,200,000
Difference ...	£4,560,000

Fifty frigates, each averaging 1,000 tons, at £30 per ton, will cost in England	£1,500,000
And if three times renewed in 50 years, the expense will be	£6,000,000
Fifty frigates of the same tonnage, not requiring to be renewed for 50 years, will at Bombay cost at £25 per ton	£1,250,000
Difference	£4,750,000
Total saving to the public in the original cost of the hulls of the ships, exclusive of what must be saved in repairs which cannot be calculated	£9,310,000

"It is expedient to have recourse to India built ships for the navy, and the East India Company, to save the British oak, of which there is an alarming and increasing scarcity, and the following calculation will shew the extent of the saving that may be accomplished. It has been computed by a very experienced and intelligent shipwright, the late Mr. Snodgrass, surveyor to the East India Company, that each ton, upon an average requires a load and a half of timber:—

Twenty sail of the line, each of 2,000 tons, require of timber	60,000 loads
Fifty frigates, each of 1,000 tons	75,000 "
Total saved	135,000 "
The number of ships at present employed by the East India Company is about 130, containing about 110,000 tons	165,000 "
	<u>300,000 loads</u>

which renewed every $12\frac{1}{2}$ years will expend per annum 24,000 loads of oak timber, which by the prosecution of building with teak, may be saved to replenish the exhausted forests of the kingdom.

(To be continued).

REVIEWS.

THE TIMBER OF CORSICAN PINE.

(PINUS LARICIO, POIRET).

The Forest Products Research Bulletin No. 6, "The Timber of Corsican Pine", issued by the Forest Products Research Laboratory, Princes Risborough, is a composite publication of considerable interest, combining in a single pamphlet the reports of the Sections of Wood Technology, Seasoning, Timber Mechanics, Wood Preservation, Utilization, and Wood Working, on the study of the species under consideration, *Pinus Laricio* (Poiret), grown in England. Sponsored as it is by R. S. Pearson, C.I.E., formerly Forest Economist at Dehra Dun and now Director of Forest Products Research in England, it cannot fail to command confidence as a reliable source of information on the properties of home grown Corsican Pine.

The first section of the bulletin presents an account of the structure of the wood, illustrated by photomicrographs at X 10 and at X 50.

The second section deals with the seasoning of the species both in the kiln and under ordinary atmospheric conditions. As might be expected Corsican Pine was found to be very tolerant of drastic kiln conditions and rapid drying, and the air-drying of the species offered no real difficulties provided it could be prevented from developing sap-stain. Useful schedules for kiln seasoning are included, but one hesitates to accept without reservation all the conclusions stated in respect to air seasoning.

The mechanical and physical properties of the wood, reported in the third section of the bulletin, are based on an adequate number of observations and are well presented. The usual relation is shown between strength and density, and it is evident that this species does not differ materially in strength functions from home grown Scots Pine. Data are submitted to indicate a greater strength in the trees which grew at the greater elevation. Inasmuch, however, as the elevation differences were only of the

order of 125 feet, and the trees were grown in positions of varying exposure, it would seem possible that the true explanation of the strength differences may lie more in the immediate environment of the individuals than in their elevation above sea level.

The fourth section of the bulletin reports the Corsican Pine to be one of the easiest conifers to impregnate with preservative both creosote and water solutions, and supplies instructions for treatment by the Full-cell, Empty-cell, and Open-tank methods.

The fifth section reports on conversion tests, wood-working qualities, and uses. While some of the information is of an extremely indefinite nature, such as reference to saws "with sufficient hook, ample spacing of teeth, sharp points and an average amount of set", the general conclusions are useful, and an appendix gives detailed information as to several machining characteristics and hand working qualities. Altogether the Corsican Pine appears to be very similar to Scots Pine, but is slightly inferior on account of its high proportion of sapwood combined with the fact that the sapwood seems to be more difficult to work than the heartwood.

This bulletin presents a large amount of useful and authoritative information in a concise and convenient form, and the Director and staff at Princes Risborough are to be congratulated on their valuable addition to the information available to the producers and users of softwood timber.

L. N. S.

**NOTES ON THE BURMESE SPECIES OF PLANTS
YIELDING CHAULMUGRA OIL.**

BY G. K. AIYAR, C. E. PARKINSON, D. H. PEACOCK,
AND G. S. SHIRLEY.

Burma Forest Bulletin No. 21 (Economic Series No. 3). Price
As. 12 from the Superintendent, Government Printing and
Stationery, Burma.

"These notes are the outcome of a survey of the Burmese plants which yield *Chaulmugra* oil, following on numerous requests from all parts of the world for supplies of the seed of *Taraktogenos Kursii*.

Very soon after a start was made in collecting the seed it became evident that there would be difficulty in ensuring that the seed collected was actually that of *Taraktogenos*. The collection had to be entrusted to subordinates of the Forest Department who only knew the seed under the Burmese name of *kalaw* and in the course of the earlier collections it was found that the name *kalaw* included a number of species of the family of *Flacourtiaceæ*.

- Amongst these was *Gynocardia odorata*, which had already been proved to contain neither chaulmugric nor hydnocarpic acid and was therefore valueless for therapeutic purposes. Practically nothing was known as to the botanical identity of the species called *kalaw* other than *Taraktogenos* and *Gynocardia* already mentioned. To avoid the risk of distributing valueless seed it was decided to carry out a botanical and chemical survey of all the species included by the Burmese under the name of *kalaw*.

As a result of this survey it has now been determined that all the identified species with the exception of *Gynocardia* yield oils containing one or other of the valuable fatty acids, and as the distribution of the various species has now been fairly accurately determined it is possible to ensure the collection of the seeds of any particular species, although in the case of the rarer ones such as *Hydnocarpus dawnensis* the remoteness of the locality renders the collection entirely uneconomical. In practice *Taraktogenos Kursii* is the only species worth considering from an economic point of view in Burma.

In addition to the botanical and chemical survey the Silviculturist of the Forest Department undertook to carry out experiments on the germination and cultivation of the various species in their early stages in order to provide information as to the behaviour of the plant in its country of origin, and a brief note is appended at the end dealing with the question of the cost of collection and the manner in which requests for the supply of the seed can be met."

FOREST FENCES.

BY M.D. CHATURVEDI.

United Provinces Forest Department Bulletin No. 3. Price Re. 1 from the Superintendent, Government Press, Allahabad.

"The necessity for protecting regeneration from excessive cattle grazing in the submontane forests has long been realized but the necessity for protection from deer and wild animals is a comparatively new conception. The introduction of systems of concentrated regeneration in our sal forests and the expansion of artificial regeneration of miscellaneous species in plantations has however, vividly impressed on all competent observers the seriousness of the problem of damage by browsing of wild animals, and opinion is now practically unanimous that steps must be taken to reduce it.

2. Of the possible alternatives, deer-proof and pig-proof fencing appears to be the only practical solution; but while the erection of a cattle-proof fence is comparatively simple, the erection of an adequate deer-proof fence has presented unexpected difficulties. Experience has proved that it must be sufficiently high to check voluntary jumping (driven deer will jump any height that is not prohibitive in cost to erect); it must be sufficiently strong, tight and close woven to prevent deer pushing through, and the area must be sufficiently small to enable deer to be driven out or destroyed that do get in (for no practical deer fence is absolutely deer proof).

3. The publication of this note coincides with a probable increased activity in the erection of deer proof fences throughout the submontane divisions, and its object is to record, in a convenient and handy form, information that will prove useful to Divisional Forest Officers in the erection of both cattle and deer fences. The practical points in erecting a fence are given in some detail, a specification of a satisfactory fence of each type is given which may be adopted as our future standard, and the estimates of cost have been worked out (both per running furlong of perimeter and per acre for any size of square) for average submontane forest conditions. Mention is also made of several

alternative methods of fencing, some of which have not as yet been tried on a practical scale, and one which has been tried but has not proved altogether successful.

4. It is hoped that the publication of this note will tend to prevent the repetition of mistakes (more specially with deer proof fences) which have resulted in the past from our inexperience, and simplify the work in what is, to a great extent, a comparatively new departure in practical forest management."

**NEW ZEALAND STATE FOREST SERVICE.—ANNUAL
REPORT OF THE DIRECTOR OF FORESTRY
FOR 1929-30.**

The following is a brief review of the major operations carried out during the year:—

Afforestation.—The new area planted was 56,630 acres (including 30 acres of direct formation), which far exceeds the area planted in any one year by any other State in the Empire. This brings the total plantation establishment to 253,603 acres, which as far as afforestation is concerned, makes New Zealand the leading State of the Empire. The programme mapped out for 1930 planting involves the afforestation of approximately 54,600 acres.

Thinning, etc.—An outstanding achievement for the year was the thinning, partially thinning, and cleaning of the majority of the older-age classes in the State plantations. That this silvicultural treatment was overdue had long been recognized, and although experimental thinning of sample plots had been undertaken from time to time, it had not been possible to operate on an organized scheme of any magnitude. The opportunity came however, when the Service was called on to assist in providing work for the unemployed, and from the month of October, 1929, till March of the present year, gangs were employed on thinning, partially thinning, and cleaning in Rotorua, Canterbury, and Otago-Southland regions.

Some 2,000 acres in a portion of Conical Hills Plantation (Otago) still remain to be dealt with, but the work already

accomplished must have an important effect by improving the health of the trees, lessening the fire-risk, and, where thinning was done, by increasing the productive volume of the ultimate timber-crop.

Unemployment.—At the peak period 1,829 hands were engaged on forestry work, and when it is remembered that many of these were city dwellers unaccustomed to the rigours of country life and to camp conditions during a wet season, it is pleasing to record that the results from a forestry view-point were comparatively satisfactory.

Waipoua Research Station.—The establishment of a silvicultural research station in Waipoua State Forest—the last of those large magnificent *kauri* forests of the North—was authorized during the year, and the necessary preparations are now in hand to enable operations to be commenced there without delay.

The functions of this Station are outlined in chapter II of the report, and although definite results cannot be obtained for some time, it is confidently expected that when the five-year-experiments and investigations alluded to have been completed, the Service will have secured data which will solve the many problems regarding the rate of growth, regeneration, habits, etc., of New Zealand's finest timber-tree.

Timber-sales.—The year's sales of indigenous timber show an increase over the figures for the previous year, and appear to indicate generally that the sawmilling industry is gradually emerging from the period of depression through which it has been passing for some years, and is becoming gradually more stabilized.

Forest-management.—A perusal of the report will show that this important branch of forestry has been given careful attention, and good work has been done with respect to forest entomology, silvicultural investigations, botanical research, etc.

Branch of Forest Products.—Timber-testing has been continued and the comparative and actual strengths, etc., of seven indigenous timbers and four imported ones were investigated. Various industrial studies—e.g., air seasoning and kiln drying, testing suitable timbers for fruit and butter boxes, testing of

insignis pine for bridge-stringers, testing creosoted rimu poles for telegraph and power lines, investigating *insignis* pine, *kauri*, etc., for supplies of turpentine oil, etc., to name but a few—together with an extensive economic pulpwood survey to ascertain the commercial possibilities of establishing the industry in the Dominion have also been undertaken.

General.—To sum up, the work of the year has been varied and arduous, and for the satisfactory results herein recorded I desire to express my thanks to officers of all ranks for their loyal co-operation and untiring energy, often under trying and very difficult circumstances, brought about by the big programme occasioning the employment of large extra numbers of labourers."

EXTRACTS.

FOREST SERVICES AND RESEARCH.

REPORT OF COMMITTEE "R"

1. We have had before us the memorandum which was prepared for the Colonial Office Conference on Forest Services and Research, and we have also been enabled to receive evidence from the following:—

The Rt. Hon. Lord Clinton, Chairman of the Board of Governors, Imperial Forest Institute.

Sir James Irvine, C.B.E., F.R.S., Principal of St. Andrew's University and Chairman of the Forest Products Research Board.

Professor R. S. Troup, C.I.E., Director of the Imperial Forestry Institute.

Mr. R. S. Pearson, C.I.E., Director of the Forest Products Research Laboratory.

Mr. R. L. Robinson, O.B.E., Vice-Chairman and Technical Commissioner, Forestry Commission, and ex-Chairman, Forestry Examining Board for the Colonial Services.

Mr. B. R. Wood, Conservator of Forests, British Guiana.

IMPORTANCE OF FORESTS IN COLONIAL EMPIRE.

2. In the first instance, we desire to call attention to the potential value of the forests of the Colonial Empire. These forests cover an area of approximately half a million square miles and represent for the most part an undeveloped asset of the greatest importance. Their proper development is a matter of considerable significance to the progress of both agriculture and industry and unlike almost all other spheres of Government activity, is capable of being made directly remunerative, if a sound forest policy is administered by an adequate staff of scientifically trained officers.

3. We wish to record also our recognition of the progress which has been made in the development of Colonial forestry since the War. The increases which have taken place in forest staffs, amounting to 80 per cent. since 1921, show that Governments are recognising more and more the importance of the proper management and conservation of their forests.

APPOINTMENT OF ADVISER ON FORESTRY.

4. We suggest that, in view of the ever-increasing development of the Colonial Forest Services, the time has come when consideration should be given to the appointment of an Adviser on Forestry to the Secretary of State for the Colonies. Even if it should not be found possible to make more than a part-time appointment in the first instance, we feel that there should be an advisory authority available to whom Conservators of Forests in the Colonial Empire can look for advice and assistance on technical questions

connected with their work. We hope, however, that circumstances will permit of the appointment of a full-time Adviser at the earliest possible moment. We consider the need for a whole-time Adviser to be as great in the Forest Services as in the Agricultural, Veterinary, and Medical Services where such posts have already been created. We contemplate that the Forestry Adviser should ordinarily be selected from the Colonial Forest Services, and that the appointment should thus be regarded as the chief appointment to be secured in those Services.

IMPORTANCE OF TRAINED STAFF.

5. As is pointed out in the memorandum prepared for the Conference it is of special importance that a Forest Department should have a properly thought out policy, based on scientific principles. Such a policy can only be prepared and carried out by a scientifically trained staff of adequate strength. The provision of such a staff is, therefore, of vital importance if Colonial forests are to be properly developed.

UNIFICATION OF COLONIAL FOREST SERVICES.

6. We are of opinion that, as for agriculture, so also for forestry, the organization of a unified Service would assist substantially in ensuring an adequate supply of well-trained recruits, and we recommend that steps towards the unification of the Colonial Forest Services, on lines similar to those which we have recommended for the Colonial Agricultural Services, should be taken as soon as possible. Such investigation as we have been able to make indicates a probability that the process of unification in this Service would not be attended with any serious difficulty, and that the additional expenditure involved would be comparatively small. With the creation of such a unified Service more accurate forecasts could be given than is possible at present as regards the number of vacancies that will be available for some years ahead, and we would call special attention to the importance of this point in connection with the Forest Services. Forestry is a specialized profession, but opportunities of employment are, practically speaking, confined to posts under Government, and a student consequently hesitates to undertake the specialized and expensive training required unless some reasonable assurance can be given that a Government appointment will be available for him when he has qualified for it.

RECRUITMENT AND TRAINING.

7. This leads us on to the question of the recruitment and training of candidates for forest appointments. From the evidence which we have received it is clear to us that the present supply of candidates is not satisfactory in respect either of numbers or of attainments. We are glad to note that a Committee has been appointed, under the Chairmanship of Sir James Irvine, C.B.E., F.R.S., to enquire generally into the training in Great Britain of candidates and probationers for Government Forest Services.

8. In the light of the evidence which we have received it appears to us by no means certain that it is necessary, or indeed desirable, to restrict

admission into the Colonial Forest Services to candidates holding a University degree in forestry. The suggestion has been made that holders of honours degrees in Natural Science should be eligible as candidates and, if selected, should be required to take a two years' probationary course of training in forestry at the Imperial Forestry Institute at Oxford, in lieu of the present course of one year required for holders of degrees in forestry. Such a two years' course would superimpose on their general scientific education the specialized training in forestry which is required.

9. The whole question is, however, under consideration by Sir James Irvine's Committee and, until that Committee has reported, it would be premature for us to express any opinion upon the advantages of this alternative method of recruitment.

IMPERIAL FORESTRY INSTITUTE.

10. We have received full information regarding the functions and work of the Imperial Forestry Institute, and it is clear to us that whatever method or methods of recruitment may be ultimately adopted, the Institute must be maintained to provide the special training necessary for forest probationers. At present most of the recruits for the Colonial Forest Services are required to take a one year's course at the Imperial Forestry Institute. The training given there has been specially adapted to Colonial needs and many members of the staff have had experience of tropical forestry. We also attach great importance to the facilities which the Institute provides for the training of specialists and for refresher courses for forest officers of some years' service.

11. We are convinced that, if only as a training centre, the Imperial Forestry Institute is of vital importance to the development of forestry in the Colonial Empire, and that it must be properly maintained if an adequately trained staff is to be recruited for the Colonial Forest Services.

12. The Institute also gives great assistance to Forest Departments in matters of research and especially in connection with identification work and the preparation of Forest Floras. In many Colonies there is still considerable ignorance of the resources of the forests, what timbers the forests contain, and to what uses they can be put, and we are glad to note that a special study is now being made at the Institute of the question of improving methods of stocktaking, and that special training is now being given in this most important branch of forestry. In this connection some interesting and important suggestions, recently made by Mr. R. Bourne, of the Imperial Forestry Institute, in a treatise on "Regional and Air Survey," have been brought to our notice. We do not feel qualified to express an opinion on them, but we would commend them to the consideration of the competent authorities.

13. We have received evidence also which shows how closely the Institute is linked with the work of the Forest Products Research Laboratory

at Princes Risborough, to which we refer in a later section of this report. In our opinion, the maintenance of the Institute, both as a training centre and as a research organization, is almost equally important to the Forest Products Research Laboratory as to Colonial Forest Departments.

(Colonial Office Conference, 1930, Summary of Proceedings.)

RAILWAY SLEEPERS.

Madras forests are now in a position to cope with the demand for wooden sleepers for railways in the country, particularly the South Indian Railway which takes about 100,000 sleepers from the Madras Presidency. It is expected that the Madras forests will be able to supply more such sleepers in future than now. The sleepers used on the broad gauge railways in this country number 82,782,000, forty-four per cent. of which are wooden sleepers. The present tendency the world over is to use metal sleepers as these are considered more economical than wooden sleepers; but Germany and Switzerland which were the first to use metal sleepers are said to be reverting to the use of wooden sleepers. In the Madras Presidency the forests in the West Coast produce more wooden sleepers than those elsewhere. The sandalwood forests in North Coimbatore have now become more productive than hitherto. The revenue last year was about Rs. 11 lakhs and this sum ought to increase unless the trade is affected by the political trouble in Bombay which is one of the largest buyers and exporters of sandalwood. The Forest Department is investigating methods by which the diseases and pests that attack sandalwood may be eradicated.

(*"Indian Engineering"*.)

TERCENTENARY OF FIRST USE OF QUININE.

Although 1638 is generally accepted as the first date in the history of quinine, Dr. George T. Moore, President of the Shaw Botanical Gardens, has established through old volumes in the Garden's library that the first recognized use occurred in 1630. In that year, he found, the bark cured the malaria of Juan Lopez Canizares, Spanish corregidor of Loxa. Traditionally, it was the corregidor who recommended the treatment to the Countess of Chincón, wife of the Governor of Peru, whose cure at Lima in 1638 gave the Cinchona tree its name.

The story of the natives, who used it for an unknown period, is that a Cinchona tree fell into a pool of water, and that a native, drinking the water, found his fever cured. Knowledge of its value was disseminated throughout Europe by the Jesuits, so that the "sacred bark" became known also as "Jesuits' bark."

(*Tropical Woods*, No. 23, 1st September, 1930.)

VISITING THE BAVARIANS ON KANCHENJUNGA

By E. O. SHEBBEARE, CONSERVATOR OF FORESTS, BENGAL, AND MEMBER OF THE BOARD OF MANAGEMENT OF THE KALIMPONG HOMES.

Kanchenjunga is to-day attracting the world's gaze as the international band of mountaineers, under the leadership of Professor G. O. Drydenfurth, set out to attempt to scale its hitherto unreached summit of 28,150 feet. We at Kalimpong, who have the surpassing privilege of enjoying the vision of Kanchenjunga in all its changing moods, are intensely interested in the expedition. The children of our Homes fondly hope that they may even see the victors wave their caps on the pinnacle of the great mountain—50 miles away—at the end of May or beginning of June.

In August last a band of nine Bavarian Mountaineers passed through Kalimpong to prospect the best approach for reaching the summit from Independent Sikkim. They were warmly received and encouraged by the Indian Government, the Sikkim State, and the Mountain Club of India. To give them practical help with their Sherpa and Tibetan porters—"perhaps the finest raw material in the world for producing climbers"—who had been recruited from among the rickshaw men of Darjeeling, Colonel Tobin and Mr. Shebbeare of Darjeeling, went each in turn for a month to visit them on Kanchenjunga. Mr. Shebbeare, who had been Transport Officer with the last Everest Expedition in 1924, kindly allows us to give the following extracts from his Diary.

UP THE ZEMU VALLEY.

The journey from Gangtok, the Capital of Sikkim, to Lachen in the north of Sikkim (10,000 feet) was uneventful. At Lachen we halted a day to let all wash and dry their clothes and to arrange for local coolies to move the stores up to the Bavarian base camp, three marches up the Zemu Valley. I had some interesting talks with Miss Kronquist, the head of the Mission and an old friend of all climbers.

The first day's march up the Zemu Valley is an easy but very messy one. Leaving the Lachen Valley path just after crossing the Zemu river, which has been spanned by a fine new suspension bridge since I was last there, the track follows the left bank of the Zemu through a dense tangle of rhododendrons with the accompanying swamps, anything from ankle to knee deep in mud. The flocks of sheep that pass on their way to the grazing grounds higher up the valley make the path an easy one to follow but do not improve the surface, if a series of mud wallows can be called a surface. The best plan is to go barefoot and so save your boots for the glacier where you will need them most, but this has the drawback that you must continually be pulling off the leeches that swarm everywhere.

THE TULUNG LAMA.

The first halt on the way up the Zemu-chu (chu is the Tibetan for river) is called Jaktang and is really almost a four-cross-road, for the path to

Tulung Monastery starts from here, on the south side of the river, and the route to the Lhonak on the north. There is an excellent cantilever bridge over the Zemu here, built by the Head Lama of Tulung Monastery, a noted bridge builder. Though this place is three long marches from Tulung with a high snow pass in between, we found him camped with a party of Lepchas (aborigines of Sikkim) repairing his bridge after the rains. He is a fine old man with the high-bridged nose of an autocrat and, in spite of his years, undertakes long journeys on foot, camping in so-called caves, often little better than an overhanging rock. He has made himself responsible for keeping the communications in the back-of-beyond in that part of Sikkim passable; a labour of love. In spite of my miserably poor knowledge of Tibetan I found him a kindred spirit, with an interest and knowledge of trees and birds and a legend to tell about every rock and stream we passed when, on my return journey, I had the pleasure of his company over one of his beloved routes.

The next day's march took us out of the slush and drizzle of the lower valley to within sight of the snout of the glacier, where we camped under two huge boulders, each providing accommodation for the party which, with the Lachen carriers, now numbered twenty-three. My little Mead tent was pitched between the two shelters and, turning in at dusk, I fell asleep, listening to the camp-fire songs of the two groups of easily contended folk (at Camp II).

THE BASE OF REST CAMP (III).

The climb up the snout of the glacier to the Base Camp of the Bavarians was easy enough. The last mile or two was almost level, following the glacier stream with hills on both sides and looking much more like a moorland scene at Home than Rongbuk glaciers or anything I have seen in Switzerland. I suppose the eastern aspect and influence of the monsoon must account for the great difference from such of the Everest glaciers as I have seen, which all led northwards on to the plateau of Tibet, but the whole subject of glaciers is a complete puzzle to me—I saw one in New Zealand, the Franz-Josef Glacier, bordered by walls of broad-leaved evergreen forest!

At the rest camp I met Luitpold. All the rest of the party were on the mountain some three or four marches higher up. We had plenty to talk about—news from the climbers, details about supplies and transport, etc. I therefore halted one day in his comfortable camp.

STORIES OF "SNOW-MEN."

Here I met my old Everest friend Nursang Bhutia, who was in charge of the party of Tibetans working stores up the glacier to the forward base. They all seemed very pleased to see me (I had brought them some jam which might have accounted for this popularity) and Nursang, I think because he thought it would please me, told me that there were a pair of *mi-gü* (i. e., Sog-pa or what the newspapers call "the abominable snowmen")

waiting for me above camp-fire. His party had heard the two "talking" together all night and he had seen their footprints in the morning in mud at the side of a little pond on the hillside. I had better say at once that this is the beginning and the end of the mi-gö as far as this account is concerned; the mud alongside the pond in question was covered with snow by the time I got there, so two interesting points, whether the mi-gö exists and whether Nursang is a liar must remain unsolved for the present.

THE ZEMU GLACIER.

The route between the rest camp and the forward base follows the Zemu Glacier all the way and, under reasonably favourable conditions, is done in three marches up and one march down. The going is bad mostly stepping from one block of stone to another, for the glacier is covered with moraine, but the scenery is some of the most wonderful I have ever seen. The way leads right past Siniolchu and Simvu with Kanchenjunga standing in front and one of the camps (IV) is under the rocks at the side of the Green Lake. To those who have not seen a glacier it is difficult to describe the immediate surroundings; the Zemu Glacier is almost entirely covered with moraine, so that one sees the ice only at rare intervals and the moraine looks like what a pile of road metal would appear to a mouse. In places the lateral moraines look like the huge sweeping curves of an unfinished railway embankment, but on a gigantic scale.

THE ADVANCED BASE CAMP (IV).

The forward base of the Bavarians was pitched at the point where the moraine begins to rise steeply to join a spur of the mountain. The surrounding moraine was under a foot or so of new snow but the camp itself was on some slabs of rock which had been cleared of snow, so it was really a rock camp. The peculiarity of rock and snow camps is that the former looks comfortable and is uncomfortable and the latter looks uncomfortable and is comfortable. At the camp I met Brenner, who had had a slight fall on the mountain and was put in charge of this base until he should recover; the remainder seven climbers and four porters were in the higher camps or rather ice-bivouacs.

This camp, though only about 17,500 feet in elevation, gave a most imposing view of Kanchenjunga whose great wall towered right above us; facing this we had Simvu a little behind the left shoulder and the east buttress of the summit peak (No. 3) of Kanchenjunga a little in front of the right. Between Simvu and the southern (No. 1) peak is the famous Zemu Gap or Cloud Gap leading from the Tulung to the Zemu Glacier.

CLIMBERS' HEROIC TASK ON EAST BUTTRESS.

The east buttress of No. 3 peak of Kanchenjunga, at the foot of which the camp stood, is a knife-edged ice ridge with its jagged profile lying back at a general angle of about forty-five degrees. This at least describes the lower part, up to perhaps 24,000 feet; higher up it lay back at a rather easier angle and even flattened out into small snow-fields in places.

It was this uninviting looking ice edge that the Bavarians were laboriously hacking into a staircase. It was killing work at that elevation and could not be kept up for more than ten minutes at a time; two climbers would work together by spells. They had been at this work for nearly three weeks at the time of my visit but this did not all represent solid progress, for their first ten days' work had been destroyed by a fall of snow. They were destined to put in about ten more days at this labour before they reached the easier part of their task when, with all technical difficulties behind them, they were driven off the mountain by a still heavier fall of snow. This, however, is no part of my story.

I halted three days in the advanced base as it was important for me to see Bauer, the leader of the expedition, and I could not intrude on the ice-bivouacs where a narrow ledge or a crack in the ice wall was often the only accommodation for climbers and porters in each of the high camps and where casual visitors might not be welcome. During that time Brenner, now almost sound, would go out with me on the face of the glacier to a rock which, projecting from the snow, offered a comfortable seat, to watch the movements of the climbers, tiny black spot three thousand feet above us. It was a lazy life but, to me, a three days' interlude in the middle of a fairly strenuous month seemed not a bad thing; Brenner, however, was naturally inclined to chafe at this idleness and wanted to get back to the bivouacs again. The camp was pleasant enough though, at night, the rocks were a rather unsympathetic couch with only half an inch of siber-down "feabag" and a thickness of Willesden canvas between them and the sleeper.

THE SINGING CHEF AT 17,500 FEET.

The presiding genius of the place was Tenchudder, one of the cooks of the Everest Expedition, good value as *chef* but better still as a radiator of good spirits. Perched in a tiny tent on a rock about six feet above the rest of the little camp he spent the whole time singing by day out of the fullness of his heart and, by night that endless monotonous chant on two notes that some public benefactor keeps going all night in these high camps to ward off wandering evil spirits from the rest of the party as a camp fire in the jungle wards off wild beast.

Tenchudder's assistant, Nursang Sherpa, was also notable as having as a boy accompanied Kellas on his ascents of Chomolung, Kanchenjha and Pauhuri—two out of these three peaks were visible from this camp when the monsoon was in abeyance in the Lachen Valley, as one looked back, straight down the glacier.

SETTING MOON AND RISING SUN.

One scene from this camp I shall never forget,—a Moon just past the full colour of burnished gun-metal in a dark blue sky setting behind the huge wall of Kanchenjunga coloured dull copper by a fore glow of the rising Sun. This fore-glow faded completely leaving the mountain a cold blue-grey before the familiar pink of dawn began to touch the summits.

WITH THE LEADER OF THE EXPEDITION.

On the afternoon of 23rd, Bauer arrived from the ice bivouacs, enthusiastic and in high spirits. He was full of praise for the Sherpas, who, he said, were prepared to follow a climber anywhere he could go and did not know what fear was. When they became more accustomed to the use of rope and axe he declared that they would almost equal a Swiss guide. The experience of expeditions employing a mixed force of Sherpas and Tibetans has shown that there is little to choose between these two splendid races either in courage or endurance.

Bauer and I had much to discuss in a short time including arrangements for a possible return of part of the expedition through Nepal and the three of us sat up late—late that is for a glacier camp, eight o'clock or so—discussing plans round the stone slab which served us for table and fireplace combined. The fire was achieved by burning a little pile of solidified spirit until the atmosphere inside the tent became almost frosty, though really not much above freezing point, and heavily charged with a mixture of methylated spirit fumes and Burma cheroots, it was not ideal perhaps, but a pleasant change from the pure, keen air of the mountain which we could get at any time. Though we had had our evening meal we consumed the best part of a huge plum cake that I had brought out from Darjeeling for men hanker after sweet things at high elevations when meat, even fresh meat, leaves them cold. As we said good night the face of the mountain was flickering at intervals as if a searchlight had been turned into it. I suppose this must have been a distant thunder storm far away over the plains of India, though there was not a cloud in any part of the sky visible to us and the stars were twinkling as frostily as ever.

THE RETURN JOURNEY.

My little party, three of us, left early the next morning. Though we had only been to the foot of the mountain I think we were all glad to turn our backs on it and look forward to an easier trip home. I had more time to look about me and enjoy the increasing number of birds and even beasts that we met as we left the region of choughs and ravans and began to see the friendly little birds that live lower down. Of animals I only saw two burhel and one or two rock mouse-hares. By two o'clock, taking it easy and brewing tea by the way, we had covered the return journey of three fairly strenuous upward marches and reached the rest camp 3,500 feet below and eighteen or twenty miles away from the forward base at which we had slept. Luitpold at his lonely post was glad to see us and hear such news as we had to give him. Next morning before leaving for Janktang I watched Luitpold taking photographs of a *lämmergeier* swooping about the camp on the look out for bones—a wonderful sight.

Now a party of five again we said good-bye to the Expedition and faced the moist gorge below where the monsoon clouds and drizzle were still hanging about, and were soon among the vegetation below the snout of

the glacier. In the afternoon we met our guide, Tsering Tondrup, who was to take us past Tulung Monastery, opposite the Jaktang bridge where we camped. He was not very confident about our being able to cross the Kishyong-la as there had been a good deal of snow lately. To our delight the Tulung Lama himself appeared before dusk. He, according to Tsering "goes through snow like a horse." I think most uneducated Tibetans, while treating such dangers as exist on high routes with absolute indifference suffer a good deal from the fear of demons in lonely camps at night. To the porters I believe the presence of the Lama was a real relief; as for me, his knowledge of legend and tradition as well as the Tibetan names of all the plants and many of the birds we saw, doubled the interest of the journey.

UNDER GUIDANCE OF THE TULUNG LAMA.

The Lama now became our guide. Next day we crossed the bridge, a very solid cantilever structure. The Lama told us that before he built it there had been a rough bridge built by the united efforts of an old man and woman and that, before that, the only way to get provisions over the Zemu-chu was to tie the food in little bags and throw it across.

SIKKIM RHODODENDRONS.

The hillside rises abruptly from the river and the path zig-zags steeply up through the rhododendrons, mostly of two species, as far as I could tell. One of these, judging by the foliage for they were of course not in flower at that time of year, seemed, to be *Rhododendron campanulatum*, the one with mauve flowers common at Sandukphu; the other one I am not so sure about, I think it may be *Rhododendron cinnabarinum*, with brick-red flowers. Whatever the species are, this hillside must be a wonderful sight in May. After climbing between two and three thousand feet the rhododendrons begin to tail off and soon the Lama stopped us at the last patch to pull out dead branches for firewood. From here we went about three quarters of a mile across old moraines covered with scanty grass in places and in places bare. A heavy mist hid the view but in clearer patches we could see the valley narrowing towards the pass. Here the Lama stopped, shouted into the mist overhead and was answered by a voice from the clouds. It appeared that he had sent a servant ahead to get the cave ready but the voice, coming from higher up than I had expected the rocks to extend, was rather startling for a moment.

MOUSE-HARES.

I pitched my tent among the rocks some distance below the mouth of the cave, the only flattish site I could see and found later that I had been lucky enough to have settled among a colony of mouse-hares. Lying in my sleeping bag I could watch them moving about within a few feet of me and apparently not interested in the tent at all. They were the rock mouse-hares, rather larger and a good deal darker than the sandy-coloured,

species so common on the Phari plain, being about the size of a guinea-pig, slaty grey with a reddish touch on the breast and tip of nose; beautifully formed little creatures with the perfect lines of the common hare.

CROSSING THE PASS.

It snowed a little during the night and next morning we broke camp early and were soon on the pass from which I was disappointed not to find a more extensive view. To the east was the peak called Lamgebo by the people of Lachen and Anden-Lama by the people of Tulung; its name in the sacred books is Gye-nyi and the Lama told us that it is one of the servants of Kanchenjunga. We dropped down steeply into the valley below, past the Lama's yak camp, through which flowed a beautifully clear little river—a trout-stream without the trout. The sides of the valley began to close in and shortly afterwards we came to a place where the whole floor of the valley seemed to have dropped about eight hundred feet leaving a great, flat-bottom depression with precipitous sides. As we climbed down the narrow path which zig-zagged down the rock-face, at places cut into the wall and at others built out with rough timber and sticks, we could see the side streams plunging over the edges of the gorge in magnificent cascades; then, where the cliff stood out a little into the valley, we looked back and saw where the Tulung stream itself dashed over the edge with a clear fall of several hundred feet; a wonderful sight. We camped for the night at a most beautiful spot, called Labya among silver firs at the foot of a great crag.

The next day's march was through forest following the course of the river which we crossed twice on sturdy cantilever bridges—again the work of our friend. Near the second bridge the silver fir changes to hemlock-spruce which should indicate an elevation of about 10,000 feet, though the map makes it nearer 8,000. Near here we were shown a rock from which a conch-shell is said to have been removed.

THE TULUNG MONASTERY.

As we approached the Tulung Monastery the wonders along the path became more frequent and the Lama's servant, who, his master having gone on ahead, was acting as our guide now, made the most of them. A trickle of holy water to wash away sin, a magic hand-hold in the rock which clasped averted danger, a library of sacred books (laminated rocks) and a rock box with a padlock to keep them in were the chief marvels.

The Tulung Monastery is a small one (though the *Gazetteer of Sikkim* gives its complement as a hundred monks, I saw none except our old friend while I was there) the building itself being about the size of a cottage. In design it is like most of the smaller Sikkim monasteries with a main hall (du-khang) in the lower storey and a porch in front with prayer wheels, at which the members of my party put in a good deal of work. Upstairs is the treasure house and some smaller rooms one of which is devoted to the worship of Kanchenjunga of whom there is a life-sized figure, the work of the late head Lama. It represents him as a fierce warrior holding an old

flint-lock musket, apparently of European manufacture. I could not help wondering what the history of this old musket might have been but the room was too dark to distinguish a maker's mark. The carving of Kanchenjunga's hands and face was good.

The Lama showed us his treasure-house in person. He seemed to take most pride in a pair of cymbals of some alloy that looked like gun metal. He told us that they were from China and had been recovered from the sea but I could not make out when and why they had been thrown there. There was a good collection of small images, some of them of gold and a variety of odds and ends,—a small elephant tusk, conch-shells and so on. Round the wall of the room were stored sealed and locked boxes and trunks said to contain the clothing of distinguished men; among others some of the robes worn by the late Maharajah at the Delhi Durbar. Some of my men found an easy way of acquiring merit by bumping their heads against each box in turn.

LEPCHA ROCK LADDERS AND CANE BRIDGES.

I was sorry to say good-bye to the Lama when the time came to push on down the valley. The path led us first down the wooded gorge and then from a prominent rock we got a sudden view into the fertile valley below well cultivated by the Lepchas. We descended from this point by typical Lepcha path with ladders lashed to the rock at the steepest pitches until, reaching the floor of the valley our way led through fields of cardamom and millet. Below the junction of the Tulung with the river that flows from the Tulung Glacier a long cane suspension bridge, made by the Lepchas, crosses the gorge. Cane bridges are, of course, never seen in Tibet proper, there being neither canes nor bamboos with which to build them of and no trees to anchor them to, but it had not occurred to me that they would be a novelty, even an alarming novelty, to Tibetan porters, men who would cross the craziest structure of branches over a roaring cataract or sheer precipice without turning a hair. Such, however, was the case. Sang-po, a youngster, had to be carried over with his eyes screwed tightly shut on the back of the sturdy Tsering Tondrup, and even old Ming-ma, who had been on two Everest expeditions, did not feel equal to carry his own load across "Tubboo" who had no doubt crossed hundreds of cane bridges during his many wanderings or when serving with the Chinese army in the Mekong valley, of course made no bones about it, nor did the Duk-pa (Bhutanese Porter), such bridges being no doubt as common in the foot hills of Bhutan as in Sikkim.

This march was the longest of the whole trip and the rest of the day was weariness. We spent the night at the village of Lintim under the friendly roof of some Lepchas, who kindly made us free of their house.

THE LAST LAP.

The next day we dropped down to the river again, some 3,000 feet, and followed it to its junction with the Tista below Singhik. I pushed on to

Singhik bungalow to have a much needed bath and enjoy the clean clothes and tin of Army-Rations which I had "coached" with the chowkidar on my way up. In this bungalow I met the first mirror I had seen since Lachen and was again struck by the look almost benevolent, a three-weeks' one makes me look like the sort of person who knocks the heroine about on the films. Two days later, with this growth removed, I dined under electric light in a palace—with the Maharajah and Maharani at Gangtok—and so ended the best month's leave I have ever taken or at least the interesting part of it.

*(Saint Andrew's Colonial
Homes Magazine.)*